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OF THE

Royal Army Medical Corps

EDITED BY

COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTED BY

LIEUTENANT-COLONEL A. E. HAMERTON, C.M.G., D.S.O., R.A.M.C.

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Original Communications.

OBSERVATIONS ON BILHARZIOSIS IN IRAQ.

By ALEXANDER HISLOP HALL, O.B.E., M.D., Ch.B.
Late Temporary Captain, Royal Army Medical Corps, and Civil Surgeon Iraq Health Service.

The invasion of the human body by worms of the genus Schistosomidæ is no new thing. By the researches of the late Sir A. Ruffer, the prevalence of schistosomiasis in Egypt as far back as the twentieth dynasty (1250-1200 B.C.) has been established [1]. To clinical observers, hæmaturia and dysentery, the most outstanding manifestations of a schistosome infection, have been known to prevail in Egypt for centuries, but it was not until 1851 that Bilharz by finding in the human portal venous system adult digenetic trematode worms, proved the association between these worms and the symptoms they produce. Siebold published the results of Bilharz's work and gave the disease the name of bilharzia (*vel* bilharziasis *vel* bilharziosis) [2]. As the causal worms belong to the family Schistosomidæ the disease is also known as schistosomiasis.

The life-cycle of Schistosomidæ in general was known to consist of a sexual phase spent in a vertebrate—the definite host—and of an asexual phase spent in a mollusc—the intermediate host. The life-cycle of those schistosomes which invade man, however, had puzzled investigators for many years, but the work of Japanese workers and the Bilharzia Mission under Leiper, elucidated the problem, and on that work depends most of our present-day knowledge of bilharzia. Leiper's complete results have been published in a masterly treatise and will be frequently referred to [3]. He showed that in Egypt:—

(*a*) There are two distinct schistosomes which pass through their sexual phase in human beings; (*a*) *Schistosoma hæmatobium* which deposits numerous terminal spined ova mainly in the bladder wall; (*b*)

S. mansoni which deposits a much smaller number of ova with lateral spines mainly in the wall of the rectum.

(*b*) That the sexual phase of *S. hæmatobium* takes place only in the molluscs *Bullinus dybowski* and *B. contortus*, while the asexual phase of *S. mansoni* takes place only in the mollusc *Planorbis boissyi*.

Another species of schistosome has been shown to invade man, but as it occurs only in the Far East it will not be considered here [4]. Other workers have since shown that there are additional species of molluscs capable of acting as intermediate hosts for *S. hæmatobium* and *S. mansoni* [5].

The ova of these schistosomes are, as noted above, deposited in the wall of the bladder or rectum of infected human beings, from there they are discharged from the urine or fæces, and if they reach water they hatch out almost immediately into active ciliated miracidia which seek about for a mollusc to invade. In the liver of the mollusc they produce sporocysts from which there develop cercariæ with very definite characteristics. These cercariæ are in turn set free in the water and invade man to begin the sexual phase over again. Unless the miracidia reach a molluscan host within a maximum period of forty-eight hours they die and a similar fate overtakes the cercariæ unless they reach their human host within a like period. These points are of importance to remember in considering methods of prophylaxis and eradication. The route by which cercariæ gain entrance to their human host was for long the subject of controversy, but Leiper, by making paraffin sections of a newly-born mouse which had been immersed for half-an-hour in cercariæ-infected water, was able to demonstrate cercariæ in various stages of actually penetrating the whole skin. He also showed that monkeys, protected from skin infection, developed bilharzia after drinking cercariæ-containing water, and that, as cercariæ are rapidly killed by the gastric juices, such infection must have taken place through the mucosa of the alimentary track between the lips and the the stomach. Having penetrated the skin or mucosa, the cercariæ gain access to the general circulation, and we next find them in the venules of the portal circulation where they develop into adult male and female worms. The mature worms then pair, the male folding itself around the female and in this position they migrate against the blood-stream towards the radicles of the portal vein, progressing by means of a ventral sucker which they possess. The great majority choose to enter the inferior mesenteric vein through which they gain access to the small veins surrounding the rectum and the base of the bladder. The female worm then leaves the male, and being of smaller calibre continues its course and deposits its ova in the venules of the submucous coat of the bladder and rectum. It then withdraws to rejoin the male worm and leaves its ova so placed that the force of the blood-stream drives their spine into the vessel wall, whence they pass mechanically and by toxic action through the tissues, and are voided by the urine or fæces as the case may be.

The time which elapses between exposure to cercariæ-containing water and the appearance of symptoms is usually about six weeks. Clinically, the diagnosis of infection in man is made by the discovery by microscopical examination of typical ova in the urine or fæces.

In surveying our present knowledge of the life cycle of schistosome worms it would appear that there are two points which are not fully explained.

(1) The course taken by the cercariæ between the penetration of the skin or mucosa of their human host and their arrival in the venules of the liver. Leiper considers this point requires further investigation, but Fairley and Bahr say: "After penetrating the skin or mucosa the cercariæ are conveyed by the venous system to the right heart and so to the lungs. Here they may conceivably be temporarily held up by the pulmonary capillaries but eventually reach the portal vein and liver. The lung of a monkey exposed to heavy infection three days previously showed no cercariæ on section."

(2) The adult worms when they migrate from the liver—and the actual migration has been observed in an exposed mesentery—have the choice of entry into any of the radicles of the portal vein but almost invariably they enter the inferior mesenteric vein. Down this vessel they proceed to the superior hæmorroidal vein which drains the series of dilated sinuses which constitute the hæmorroidal plexus. That plexus communicates freely in front with the vesical plexus and through it with the pudendal plexus; it is also drained by the middle hæmorrhoidal vein, a tributary of the internal iliac vein. The worms have thus access to all the great venous plexuses surrounding the rectum, bladder and prostate and from these have access to the systemic venous circulation *via* the middle hæmorrhoidal vein. In thousands of cases I have seen where the presence of ova in the urine has proved the presence of worms in the vesical plexus, it has struck me as strange that none presented symptoms suggesting that the adult worms had passed further into the systemic circulation and had been held up by the lung capillaries. Even cases due to the passage of ova into the general circulation are rare. What influence then guides the worms from the liver into the inferior mesenteric vein, the only tributary of the portal vein which will give them access to the vesical plexus, and what influence discourages them from passing on further into the systemic venous circulation?

Considering the absence of valves in the portal venous system and the arrangement of the valves which exist in the systemic veins, I am inclined to think the influence is not a mechanical one. Can it be of the nature of a chemiotaxis exerted by some substance absorbed from the lower end of the bowel or must we be satisfied to regard the migration in the same light as that of the guinea-worm which "conformably to her instinct" (as Manson-Bahr says) when mature bores through the tissues to that part of the body surface most liable to come in contact with water. This

"instinct" in ordinary cases leads the worm to the legs and feet but in the case of water carriers whose occupation means that their back is constantly wet, the same "instinct" directs the guinea-worm to the skin at the back.

In its vertebrate host the schistosome may produce an infection of a latent type; its symptoms may apparently be of a local character, or more rarely it may produce death rapidly by blocking the portal circulation. Milton, speaking from an extensive experience of the disease in Egypt, says: "Bilharzia itself is quite equal to the task of destroying its victim, which it does in a large number of cases and with unspeakable torture" [7]. A disease against which such an indictment can be pronounced surely demands the efforts of all to alleviate the suffering it produces and to eradicate it from those countries where it prevails.

A detailed account of the geographical distribution of human schistosomiasis has been given by Milton [8]. The disease, as noted above, is very widespread in Egypt. In South Africa it is also very common, and of 625 of our soldiers who became infected during the South African War, 359 were still drawing pensions in 1911 [9]. Harley has published the results of much work he has done on the subject there [10]. Its presence as an endemic disease in Western Australia [11], [12], has been established, while most of the cases reported from India appear to have been imported from other countries [13], [14]. The disease has also been reported from other parts of North Africa, from East and West Africa, from the West Indies [15], Central America, Palestine, Arabia and Persia. In 1921, an account of cases occurring in Portugal was published [16], [17]. It was first reported from the country now known as Iraq by Sturrock in 1899 [18]. I quote in full Dr. Sturrock's[1] letter from page 1543 of the *British Medical Journal,* December 2, 1899.

"In 'Tropical Diseases,' by Patrick Manson, M.D., F.R.C.P., published by Cassell and Co. in 1898, the geographical distribution of bilharzia hæmatobia is stated to be limited to Africa and its island dependencies. I regret to say that the disease is widespread thoughout Mesopotamia, occurring in those living in towns and villages situated on the banks of the River Tigris and Euphrates. I have been able to trace it up to about 900 miles from the mouth of the united rivers, but so far no patients have applied for treatment who dwell upon the rivers, where the influence of the tide of the Persian Gulf is felt. Vesical calculus is more common above Baghdad where apparently there are more cases of bilharzia hæmatobia."

Attention was next drawn to the existence of the disease in Iraq by an outbreak which occurred in 1917 among the Indian personnel of one of the military hospitals in Basrah. It was at first thought that the disease had been imported and the infection spread by an Egyptian labour corps which was encamped near the hospital, but investigations proved that bilharzia

[1] P. S. Sturrock, M.B., B.C., Church Missionary Society, Baghdad.

was endemic in the neighbourhood and also in many of the surrounding districts. An interesting account of this epidemic was published by Boulenger [19], [20].

The writer of the present article served with the Army in Iraq for two years, and subsequently in the Iraq Health Service from 1919 to 1922; he had, therefore, ample opportunity for observing the disease as it affects many parts of Iraq. The extent to which the disease is endemic throughout the country is not fully brought out by either of the reports mentioned above. My experience would lead me to say that bilharzia is most prevalent on the Euphrates Valley from the Hindiyah Barrage to the sea. That it does exist in areas affected by the tide of the Persian Gulf will be shown later.

The problem of the disease in Iraq differs according to the locality in which it is met, and I shall therefore discuss it as it occurs first in a typical rural area, and secondly as it occurs in an urban district.

Bilharzia in a Rural Area of Iraq, namely, the Division or Liwa of Diwaniyeh.

The Liwa of Diwaniyeh takes its name from the town so called, situate just over a hundred miles from Baghdad on what used to be the main Euphrates channel. The channel of the rivers in Iraq is subject to frequent alteration occurring as the result of silting. About fifty years ago the Euphrates forsook the channel on which Diwaniyeh stands, and it was only in 1913, after the erection of the Hindiyah Barrage eighty miles up stream of that town, that an adequate amount of water was redirected down to the old channel now known as Hillah channel.

The water so redirected is almost all used up for irrigation purposes, and only a small quantity finds its way back to the main channel a few miles above Samawah town. The amount of water entering the Hillah channel can be regulated by the adjustment of the barrage gates. Eleven miles upstream of Diwaniyeh the Hillah channel divides into two, the Dagharah channel which spends itself in the desert, and the Rumaitha channel which flows past Diwaniyeh on through the district of Rumaitha to rejoin the main channel. The Liwa, therefore, depends upon the activities of the irrigation department at the Hindiyah Barrage for the supply of water which makes it capable of supporting its large population of 200,000 souls. We shall see later that on the further activities of that department will depend the improvement of the health of the district so far as bilharzia is concerned. Almost the entire population is engaged in agricultural pursuits, and their work in the fields, barefooted, means constant exposure to infection from bilharzia.

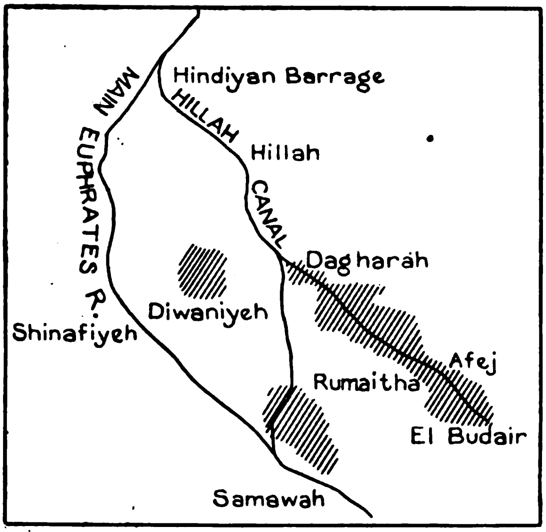
The land may be divided into two types :—

(*a*) Flow land which is on such a level relative to the adjacent river that it can be watered by the natural flow of water led in channels radiating from a breach in the river bank. Such land, unless the breach in the

river bank be closed, receives a constant supply of water, and is therefore a suitable breeding-place for molluscs all the year round. It is cheap to farm and is consequently thickly populated.

(*b*) Lift-land, which is on such a level relative to the adjacent river that the water does not flow on to it, but must be raised by means of water wheels or pumps before it can be distributed over the surface. Such mechanical devices are expensive to work, and are only put into operation when the crops require water, consequently there are long periods between crops when the land is dry, and therefore unsuitable as a breeding-place for molluscs.

The towns of the Liwa, whose population exceeds 5,000, number eight, and of these, three are built on land not liable to flooding either by over-



Sketch map showing the bifurcation of the Hillah Canal and the most heavily infected areas in the Diwaniyeh Liwa.

flow or seepage, while within the bounds of the other five water is liable to collect and form suitable breeding places for molluscs.

To this Liwa of Diwaniyeh I was posted as civil surgeon in March, 1919, having previously spent a year in the area as medical officer of an Indian regiment. After a few weeks' work in the out-patient department I became convinced that the district was heavily infected with bilharzia. Intelligent local inhabitants consider that at least eighty per cent of the population is infected and my experience, gathered in routine hospital work and at clinics held during frequent tours of the division, suggests that such an assessment is no exaggeration. Further experience showed that practically all the cases came from the "flow" land and from the low-lying towns in the small irrigation channels and stagnant pools of which innumerable snails could be found. Infected snails are readily recognized even

by the naked eye as their shells are friable and the swollen liver of the mollusc shining through gives the shells a yellow appearance. The higher towns and the lift land produced very few cases and it was very rarely that any snails could be found in their waters. While a regimental medical officer I encouraged bathing parades in these waters and not a single case of infection took place. Conditions in the district were unsettled, laboratory equipment was meagre and pressure of other work was great but many hundreds of microscopical examinations were made and in all cases the infection was found to be due to *S. hæmatobium*. My personal records of these cases were unfortunately not recovered after the rebellion of 1920. Cases occurred at all ages from two years upwards and even in patients who had more than reached the allotted span. Rectal symptoms were exceptional, nor did uncomplicated cases of bilharzia frequently apply for treatment. Hæmaturia is so common that it has come to be regarded as a normal rather than an abnormal condition. The majority of the patients came seeking relief for conditions which, although they did not realize the fact, were sequelæ of a bilharzia infection. Anæmia with its consequent debility, pyogenic infections of the bladder, hydronephrosis, pyonephrosis, periurethral abscess, stricture, urinary fistulæ both of the roof and floor variety [21], vesical, urethral and renal calculus, these were among the conditions we were most frequently called upon to treat. Carcinoma among natives is a rare condition but I have twice seen carcinoma of the bladder associated with a bilharzial infection. Lithotrity and lithotomy were the operations which headed our operation list. In such a district symptomatic treatment was the only one which could be adopted. It might be argued that if the uncomplicated disease does not drive the ordinary citizen to seek treatment it cannot therefore interfere much with the life of the community. I am convinced, however, that it does to a serious extent affect the stamina and labour producing power of the population and think the point is well illustrated by our experience in the case of the local levies or gendarmerie. In the early days men were enlisted into those services without medical examination but it was soon found that a large number of these men were unable to stand the strain of sustained military training. They were then sent to me for examination and almost without exception their incapacity was found to be due solely to debility resulting from constant hæmaturia. Action then is called for to raise the population from its C3 standard, but curative methods will be of no avail if they are not accompanied by preventative methods. Curative methods on a scale which would make any impression on the prevalence of the disease would involve a huge staff and great expenditure. Just as what we call curative methods would break the life cycle of the schistosome within its human host so preventive measures must aim at breaking the life cycle of the worm outside that host. The conceptions of sanitation which the ordinary rural Arab has, if indeed he has any, are such as to render impracticable any scheme to deal with the ova in the infective discharges of the

human host. Destruction of the cercariæ would be futile unless we at the same time destroyed the molluscs which continually produce them. Our only hope then is to destroy the intermediate host which keeps up the supply of cercariæ and any plan we adopt to do this must be practicable and economical and at the same time there must be reasonable prospect of its being followed by such a measure of success as to make it worth while.

The possibility of materially reducing the molluscan fauna by means of ducks and wildfowl has been considered in Egypt [22], [23]. As huge flocks of ducks, the numbers and varieties of which must be seen to be believed, inhabit the low lying areas of Iraq for five months each winter, I am convinced that such a proposal must occupy a very subsidiary part in any serious scheme for dealing with the country at large. It might however be useful in dealing with small localized areas where infection exists.

Leiper has shown that after being subjected to drying for a period of fifteen days very few snails recover [24]. Can we devise any scheme applicable to a district such as Diwaniyeh, by which this method of destroying the intermediate host by drying can be put into operation? The crops at present consist of winter crops of wheat and barley grown on lift land and on the higher levels of flow land and summer crops, chiefly rice, grown on the lower flow land especially near the termination of the Dagharah and Rumaitha branches. The winter crops require water up to the end of March while the summer crops are watered up till the end of August. To ensure thorough drying of the molluscs for fifteen days would involve closing the canals for at least two summer months because of the time required for the water to drain off and evaporate from the canal beds. The drying process already takes place in all lift areas and in the high level towns; it can be accomplished by building regulators at the head of canals irrigating the higher flow lands; while in low lying rice growing districts and towns it can be only accomplished by completely stopping the flow of water in the Dagharah and Rumaitha channels. Nothing therefore short of complete closure of the Dagharah and Rumaitha channels will effect drying in all the areas concerned. One objection which might be raised is that there would remain during the drying period no water for the drinking and household supply of the population, but from experience of previous dry periods of a somewhat shorter duration I am of the opinion that deep wells in the channel beds would afford an ample water supply for two months. The drying process is therefore practicable in all the districts under consideration.

What expenditure would be involved in carrying out the process? In lift areas none. In high level flow areas the construction of regulators is also desirable for irrigation purposes and is indeed already a part of the programme of the irrigation department and would therefore involve no expenditure which has not already been foreshadowed. The complete

closure by means of a temporary Arab brushwood and earth dam of either the Dagharah or the Rumaitha canal where they are formed by the bifurcation of the Hillah channel would cost only a few thousand rupees and considering the large amount of revenue which the Diwaniyeh pays the central funds, this small expenditure cannot be grudged. In addition to the actual outlay, however, the closure of either the Dagharah or the Rumaitha canal would involve the sacrifice of the summer crops grown on the area irrigated from that particular canal and consequently would involve loss of revenue from the area. If the Dagharah canal were dealt with one year and the Rumaitha canal during a subseqnent year the effect on the total revenue would not be severe. Unfortunately the nature of the soil in those low lying areas is such that, while they will bear a summer crop they are not suitable for growing winter crops, therefore substitution is not feasible. The prohibition of summer crop raising for one year on the Dagharah canal and for a subsequent year on the Rumaitha canal would not, if due warning were given, be responsible for any undue disturbance in these areas. The low lying towns would of course benefit from these measures but one other factor is worthy of mention in their case. The houses in these towns are built almost entirely of soil mixed with water and chopped straw to a consistency suitable for moulding into bricks. The Arab to avoid trouble and expense takes the soil from the nearest available source and consequently the zealous builder leaves in his trail a series of excavations in the ground. These soon fill with seepage water and form ideal breeding places for snails. The water in them is stagnant and soon comes to contain cercariæ in much greater concentration than the slow flowing water of the irrigation channels. The filling in of such excavations will mean the removal of a frequent source of infection.

Could it be reasonably expected that such a scheme to carry out the drying process would be followed by success in such measure as to justify its adoption? In my mind the existing state of affairs in the lift land furnishes the answer to this question, and the answer in an emphatic "Yes." The Hinaidi experiments, quoted later in this paper, also support the view that this scheme would achieve success. The destruction of the vast majority of the molluscs would inevitably follow the drying process, and, although an infected population would still remain, the miracidia hatching from the ova in their infective discharge would have little or no chance of finding an intermediate host, and the life cycle would be terminated. Consequently re-infection of man would not occur, those already infected would have a chance to recover from this often fatal and always exhausting disease, and those not already infected, including the rising generation, would not have to pay the heavy toll in life and suffering which has been exacted from previous generations.

A scheme along the following lines would, I suggest, be practicable, successful and not beyond the financial capabilities of the country.

(*a*) The early construction of head regulators on all channels which tap

the Dagharah and Rumaitha canals. Complete closure of these regulators after the requirements of the winter crops have been satisfied. Being permanent structures these regulators remain available for future use should molluscs reappear.

(*b*) Complete closure of the Dagharah canal for two months after next winter crop is mature, followed in a subsequent year by similar complete closure of the Rumaitha canal.

(*c*) Facilities for curative treatment in the heavily infected area on the Dagharah and Rumaitha canals. Being a strong believer in the power of the human body to rid itself of bilharzia infection provided reinfection is not constantly occurring I lay comparatively little importance on this part of the scheme, and it has the additional disadvantage that to be carried out on a large scale it would involve considerable expenditure.

(*d*) The filling in of all pits lodging stagnant water within the low lying towns, and the prohibition of further excavations within their limits.

The first effect of these measures may be an apparent increase in the incidence of bilharzia, because when the water is first cut off from the canals the concentration of cercariæ in them is increased on account of the diminished volume of water. I have noticed this increased incidence following the period when the whole canal has been closed for the annual repairs at the Barrage. The eventual result of this scheme would, I am convinced, prove that any money expended had been soundly invested, and would pay a handsome dividend in the shape of a reduced mortality, and in a diminution of the number of C3 members of the community. The problem of bilharzia, therefore, in a rural area of Iraq, such as we have been considering, although it presents many difficulties, presents none which are insuperable.

(*To be continued.*)

EXPERIMENTS IN AGGLUTINATION AND ABSORPTION WITH THE SALMONELLA GROUP OF ORGANISMS.

By Captain H. J. BENSTED, M.C.
Royal Army Medical Corps.

This paper is the outcome of suggestions, by the Professor of Pathology Royal Army Medical College, that Sir Frederick Andrewes' work upon the group agglutinins in the Salmonella group of organisms should be repeated.

The experiments were carried out with typical strains of the four members of the group, viz., 3 strains of *Bacillus paratyphosus* B, 6 strains of *Bacillus paratyphosus* C, 2 strains of *Bacillus aertrycke* "Mutton," and 7 strains of the "Newport" type (6 of which were very

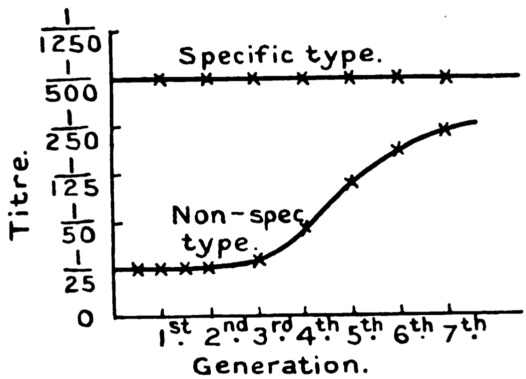


Fig. 1.—The two types of *B. aertrycke* "Mutton" tested against "Mutton" mono-specific serum.

kindly supplied by the Lister Institute from the National Collection of Type Cultures).

All the strains were fully examined against the stock sera by direct and absorption methods before commencing the experiments and all the strains were found to be normal in every way.

Unless otherwise stated, all agglutination experiments were carried out upon "twenty-four hours" broth cultures, killed in formalin and diluted to standard opacity with 0·1 per cent formol-saline, by Dreyer's method.

The majority of the experiments with the "Newport" strains were carried out with "Newport College," but the chief experiments were confirmed with the other six strains, especially "N. Hough" or "N. Feutry."

The first organism examined was *B. aertrycke* "Mutton." A mono-specific serum for "Mutton" was prepared as described by Andrewes by saturation with the three remaining members of the group. Twenty colonies were picked off into broth from an agar plate inoculated from an

ordinary stock strain and examined with specific and group sera. According to Andrewes' classification thirteen were found to be specific and seven non-specific. Subcultures were made of both types from broth to broth every twenty-four hours and incubated for twenty-four hours. By careful selection it was found possible to breed a pure "specific" for nine or ten generations but the "non-specific" invariably became mixed at the third or fourth generation.

The fourth generation of the "non-specific" type was plated out and six colonies picked off into broth and examined with a mono-specific serum twenty-four hours later:—

Colony	Titre						
	1/25	1/50	1/125	1/250	1/500	1/1250	1/2500
No. I	++	+	–	–	–	–	–
„ II	++	+	–	–	–	–	–
„ III	++	+	–	–	–	–	–
„ IV	++	++	++	++	++	++	+
„ V	++	+	–	–	–	–	–
„ VI	++	++	++	++	++	++	+

++ Complete agglutination. + Partial agglutination. – No agglutination.

That is, two out of the six were found to be of the "specific" type, whereas the original culture was pure "non-specific."

It was found that if the subcultures were made upon dry agar slopes instead of in broth this change did not take place.

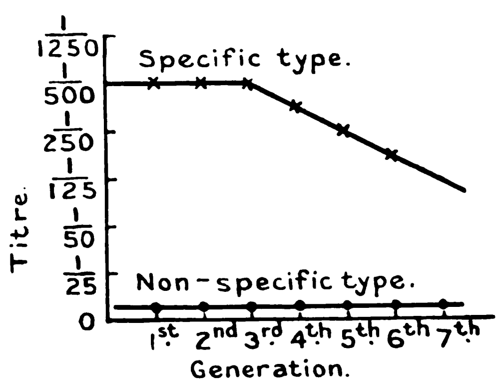


FIG. 2.—When dry agar was used as a medium.

Indeed the "specific" began to approach the "non-specific" in agglutinability. One suspected that this was due rather to a general loss of sensibility as Eisler and Silverstein found, for with wet agar the downward curve was less marked, although there was no upward curving. If each "dry" agar generation was subcultured (when twenty-four hours old) into broth it was found that this curve followed the lines of Curve No. 1.

It was then decided to examine the other members of the group with regard to these properties. Stock strains of *B. paratyphosus* B, *B. paratyphosus* C and the "Newport" type were plated out upon agar and

twelve colonies picked off into broth, and examined twenty-four hours later with specific and group sera of each strain. (A small quantity of mono-

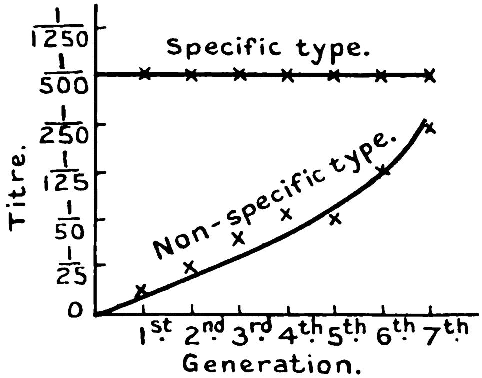


Fig. 3.

specific serum for *B. paratyphosus* B, *B. paratyphosus* C and "Newport" had been prepared previously.)

B. paratyphosus B—

Group serum. No. of colony	Titre 1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
1	++	++	++	++	++	−	−	−	
2	++	++	++	++	++	++	++	++	−
3	++	++	++	++	++	++	++	+	−
4	++	++	++	++	++	−	−	−	−
5	++	++	++	++	++	++	++	++	−
6	++	++	++	++	+	−	−	−	−
7	++	++	++	++	++	−	−	−	−
8	++	++	++	++	++	++	++	+	−
9	++	++	++	++	++	++	++	++	−
10	++	++	++	++	++	+	−	−	−
11	++	++	++	++	++	−	−	−	−
12	++	++	++	++	++	++	++	++	−
Mono-specific serum									
1	++	++	++	++	++	+	−	−	−
2	−	−	−	−	−	−	−	−	−

B. paratyphosus C—

Group serum. No. of colony	Titre 1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500	1/25000
1	++	++	++	++	++	++	++	++	++	−
2	++	++	++	++	++	++	++	++	+	−
3	++	++	++	++	++	++	++	++	++	−
4	++	++	++	++	++	++	++	++	++	−
5	++	++	++	++	++	++	−	−	−	−
6	++	++	++	++	++	++	+	−	−	−
7	++	++	++	++	++	++	++	++	++	−
8	++	++	++	++	++	++	++	++	++	+
9	++	++	++	++	++	++	++	++	+	−
10	++	++	++	++	++	++	++	++	+	−
11	++	++	++	++	++	++	++	++	++	−
12	++	++	++	++	++	++	++	++	+	−
Mono-specific serum										
1	−	−	−	−	−	−	−	−	−	−
5	++	++	++	++	++	++	+	−	−	−

B. aertrycke Newport—

Group serum.

No. of colony	1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500	1/25000
	Titre									
1	++	++	++	++	++	−	−	−	−	−
2	++	++	++	++	++	++	++	++	+	−
3	++	++	++	++	++	−	−	−	−	−
4	++	++	++	++	++	++	++	++	+	−
5	++	++	++	++	++	−	−	−	−	−
6	++	++	++	++	++	−	−	−	−	−
7	++	++	++	++	++	−	−	−	−	−
8	++	++	++	++	++	++	++	++	++	−
9	++	++	++	++	++	−	−	−	−	−
10	++	++	++	++	++	+	−	−	−	−
11	++	++	++	++	++	−	−	−	−	−
12	++	++	++	++	++	++	++	++	++	+

Mono-specific serum

Colony No.	1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000
	Titre							
1 ..	++	++	++	++	++	++	++	−
2 ..	−	−	−	−	−	−	−	−

In the case of *B. paratyphosus* B it was found that there were equal numbers of specific and non-specific. *B. paratyphosus* C only showed two out of the twelve to be specific, whilst in the case of "Newport" eight were specific and four non-specific.

The reaction of the *B. paratyphosus* C East Africa was controlled by examining the other strains, and it was found that the average number of specific organisms present in each strain was about 50 per cent.

It was then decided to examine more fully in this respect the "Newport" strains. Two samples of "Newport" sera were taken from the cold store and tested against the Standard Laboratory Agglutinable Broth Cultures:—

	Titre									
Number 1	1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500	1/25000
Newport ..	++	++	++	++	++	++	++	++	−	−
Mutton ..	−	−	−	−	−	−	−	−	−	−
Para B ..	++	+	−	−	−	−	−	−	−	−
Para C ..	−	−	−	−	−	−	−	−	−	−
Number 2										
Newport ..	++	++	++	++	++	++	++	++	++	−
Mutton ..	++	++	++	++	++	++	++	++	+	−
Para B ..	++	++	++	++	++	++	++	++	−	−
Para C ..	++	++	++	++	++	++	++	++	−	−

Serum No. 1 was looked upon as a mono-specific serum, prepared unintentionally, for, on examining the records concerning the preparation of this serum, it was found to have been prepared from a pure stock culture in the usual manner, and not examined previously for the presence of group agglutinins. A mono-specific serum was also prepared by absorbing ten cubic centimetres of the group serum (No. 2) with cultures of *B. paratyphosus* B, *B. paratyphosus* C and *B. aertrycke* "Mutton." This serum was found to behave towards the group in exactly the same way as serum No. 1 after its *B. paratyphoid* B agglutinins had been removed by absorption.

From the experiment with twelve colonies of the "Newport" organism, broth cultures of colonies Nos. 1, 2, 3, 4, 5 and 8 were examined with the specific serum just prepared. Complete agglutination was seen in cultures from Nos. 1, 3 and 5, in a dilution of 1/2500, and cultures Nos. 2, 4 and 8 showed no agglutination whatever at a dilution of 1/25. In order to show whether the two types were breeding true, successive broth cultures for six generations were examined with the "specific" and "non-specific" sera :—

Generation	Type S. or N.	Titre. Specific Serum								
		1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
1	S.	++	++	++	++	++	++	++	+	−
	N.	−	−	−	−	−	−	−	−	−
2	S.	++	++	++	++	++	++	++	+	−
	N.	−	−	−	−	−	−	−	−	−
3	S.	++	++	++	++	++	++	++	+	−
	N.	−	−	−	−	−	−	−	−	−
4	S.	++	++	++	++	++	++	++	+	−
	N.	++	±	−	−	−	−	−	−	−
5	S.	++	++	++	++	++	++	++	+	−
	N.	++	+	−	−	−	−	−	−	−
6	S.	++	++	++	++	++	++	++	+	−
	N.	++	+	−	−	−	−	−	−	−
		Group Serum								
1	S.	++	++	++	++	++	−	−	−	−
	N.	++	++	++	++	++	++	++	++	+
2	S.	++	++	++	++	++	−	−	−	−
	N.	++	++	++	++	++	++	++	++	+
3	S.	++	++	++	++	++	−	−	−	−
	N.	++	++	++	++	++	++	++	++	+
4	S.	++	++	++	++	++	++	+	−	−
	N.	++	++	++	++	++	++	++	++	+
5	S.	++	++	++	++	++	++	+	−	−
	N.	++	++	++	++	++	++	++	++	+
6	S.	++	++	++	++	++	++	+	−	−
	N.	++	++	++	++	++	++	++	++	+

It will be noticed that between the third and fourth generation both the specific and the non-specific begin to change in their agglutinability, but that this change is not marked, and that it does not progress.

The other strains of "Newport" were then examined in the reactions given by the "Newport" College strain. The strains were plated out on agar and and six colonies picked off into broth and examined with specific and non-specific sera :—

N. Hough—All six colonies found to be specific.

N. Feutry—Five specific, one non-specific.

N. Pig A2—Four specific, two non-specific.

N. Pig D1—All six colonies found to be specific.

N. Newport 5—Three specific, three non-specific.

N. Stade—Four specific, two non-specific.

Hough—Replated and twelve colonies examined, eleven specific, one non-specific.

Pig D1—Replated and twelve colonies examined. All twelve found to be specific. A further twelve colonies examined from the same plate and one non-specific form found.

The power of breeding true to type varied with the different strains. Hough, Feutry and Pig D1 specific types remained pure after the sixth generation, although the non-specific became mixed after the fourth generation. Pig A2 reacted as College. "Newport" 5 remained pure in both types up to the fifth generation. Stade was unsatisfactory as it was found to produce mixed colonies.

It was realized at this stage that the above test for true breeding had no great value, owing to the fact that a colony might not be absolutely pure yet contain so little of the other type that it might be missed by the agglutination test in the first generation, but this might develop quite rapidly and become very obvious in a later generation. It was therefore decided to repeat the experiments upon cultures (of both types) which had been isolated from single cells. A modification of Barber's technique was used for this purpose and the fluid medium containing the single bacterium was blown from the pipette on to an agar slope. Three times a single cell of the "specific Newport" type was successfully isolated and once a single cell of the "non-specific Newport" type. The single colonies which developed on the agar were subcultured into broth, and after twenty-four hours' incubation subcultures were made on large agar plates. Two series of twelve colonies were then picked off each plate into broth after twenty-four hours' incubation and examined, after being incubated overnight, with specific and group sera. In each case every one of the twenty-four broth cultures examined proved to be of the same type as its original culture, the clear-cut end-points showing that they were quite pure.

In all the experiments now to be described absorption was carried out by washing off the bacterial growth from the agar with pure serum. In the case of plates and slopes the water of condensation was evaporated off in the incubator and a comparatively dry inoculum used, and in the case of Roux bottle cultures the excess inoculum was drained off after two hours' contact in the incubator. After washing the growth from the media the mixture of serum and organisms was distributed into centrifugal tubes and allowed to remain in intimate contact for two hours in the incubator and then anything from a few hours (say three) to overnight at room temperature. Usually one hour's centrifugalization at high speed gave a perfectly clear serum which had not suffered any dilution. By this method one knew that any loss of agglutinin (except for traces) was due to the absorption.

Wherever specific and non-specific "Newport" cultures are now mentioned it is to be understood that they are single organism cultivations unless otherwise stated.

One cubic centimetre of ordinary "Newport" group serum was absorbed with two agar slopes of a non-specific "Newport" and then tested against the cultures named below. Where the cultures are named: "Newport," "Mutton," Para B, Para C, it is to be understood to refer to the normal agglutinable culture, which is a mixture of both specific and non-specific.

Culture	Titre before absorption	Titre after absorption 1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/12500	++	++	++	++	++	+	–	–	–
,, specific ..	Not known	++	++	++	++	++	++	++	++	–
,, non-specific	Not known	–	–	–	–	–	–	–	–	–
Mutton	1/5000	–	–	–	–	–	–	–	–	–
Para B	1/5000	–	–	–	–	–	–	–	–	–
Para C	1/2500	–	–	–	–	–	–	–	–	–

This shows that the non-specific type can not only absorb its own non-specific agglutinins, but also the non-specific agglutinins of the other members of the group. The reaction is confirmed by the experiments recorded below. The extremely close relationship between the non-specific types of all the members of the Salmonella group is thus clearly indicated. Indeed the only way by which one has been able to distinguish them, as Andrewes suggested, has been by allowing moist agar cultures to remain at room temperature until its own specific type develops or by injecting live cultures into animals. (See later.)

Newport Group Serum absorbed with Cultures of Para B (Non-specific).

Culture	Titre before absorption	Titre after absorption 1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000
Newport	1/12500	++	++	++	++	++	–	–	–
,, specific	N.K.	++	++	++	++	++	++	++	–
,, non-specific	N.K.	–	–	–	–	–	–	–	–
Mutton	1/5000	–	–	–	–	–	–	–	–
Para B	1/5000	–	–	–	–	–	–	–	–
Para C	1/2500	–	–	–	–	–	–	–	–

Newport Group Serum absorbed with Cultures of Non-specific Para C.

Culture	Titre before absorption	Titre after absorption 1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/12500	++	++	++	++	++	+	–	–	–
,, specific	N.K.	++	++	++	++	++	++	++	+	–
,, non-specific	N.K.	–	–	–	–	–	–	–	–	–
Mutton	1/5000	–	–	–	–	–	–	–	–	–
Para B	1/5000	–	–	–	–	–	–	–	–	–
Para C	1/2500	–	–	–	–	–	–	–	–	–

Newport Group Serum absorbed with Cultures of Non-specific Mutton.

Culture	Titre before absorption	Titre after absorption 1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/12500	++	++	++	++	++	++	–	–	–
,, specific	N.K.	++	++	++	++	++	++	++	++	–
,, non-specific	N.K.	–	–	–	–	–	–	–	–	–
Mutton	1/5000	–	–	–	–	–	–	–	–	–
Para B	1/5000	–	–	–	–	–	–	–	–	–
Para C	1/2500	–	–	–	–	–	–	–	–	–

Para B Group Serum absorbed with Cultures of Non-specific Newport.

Culture	Titre before absorption	Titre after absorption 1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/1250	–	–	–	–	–	–	–	–	–
Mutton	1/1250	–	–	–	–	–	–	–	–	–
Para B	1/5000	++	++	++	++	++	++	++	+	–
Para C	1/500	–	–	–	–	–	–	–	–	–

PARA C GROUP SERUM ABSORBED WITH CULTURES OF NON-SPECIFIC NEWPORT.

Culture	Titre before absorption	Titre after absorption								
		1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/1250	–	–	–	–	–	–	–	–	–
Mutton	1/1250	–	–	–	–	–	–	–	–	–
Para B	1/1250	–	–	–	–	–	–	–	–	–
Para C	1/12500	++	++	++	++	++	++	++	+	–

MUTTON GROUP SERUM ABSORBED WITH CULTURES OF NON-SPECIFIC NEWPORT.

Culture	Titre before absorption	Titre after absorption								
		1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/500	–	–	–	–	–	–	–	–	–
Mutton	1/12500	++	++	++	++	++	++	++	–	–
Para B	1/500	–	–	–	–	–	–	–	–	–
Para C	1/125	–	–	–	–	–	–	–	–	–

One cubic centimetre of a specific "Newport" serum, having a titre of 1/5000 when tested against its own organism, was saturated with two agar slopes of a pure non-specific "Newport" for three hours. When retested the titre was just a trace under 1/5000. This serum was further saturated with two more agar slopes of the pure non-specific "Newport" for the same period, and on testing again with the specific cultures the titre was found to have remained the same. It is clear therefore that a pure non-specific "Newport" is quite incapable of removing agglutinins from a specific "Newport" serum.

It should follow from the above that a pure specific "Newport" would be incapable of absorbing any group agglutinins from its own group serum or any other member of the group.

NEWPORT GROUP SERUM ABSORBED WITH CULTURES OF NEWPORT SPECIFIC.

Culture	Titre before absorption	Titre after absorption								
		1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/12500	++	++	++	++	++	+	–	–	–
,, specific	N.K.	–	–	–	–	–	–	–	–	–
,, non-specific	N.K.	++	++	++	++	++	++	++	++	–
Mutton	1/5000	++	++	++	++	++	++	++	+	–
Para B	1/5000	++	++	++	++	++	++	++	+	–
Para C	1/2500	++	++	++	++	++	++	+	–	–

PARA B GROUP SERUM ABSORBED WITH CULTURES OF NEWPORT SPECIFIC.

Culture	Titre before absorption	Titre after absorption								
		1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/1250	++	++	++	++	++	++	–	–	–
Mutton	1/1250	++	++	++	++	++	++	–	–	–
Para B	1/5000	++	++	++	++	++	++	++	+	–
Para C	1/500	++	++	++	++	++	–	–	–	–

PARA C GROUP SERUM ABSORBED WITH CULTURES OF NEWPORT SPECIFIC.

Culture	Titre before absorption	Titre after absorption								
		1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport	1/1250	++	++	++	++	++	++	–	–	–
Mutton	1/1250	++	++	++	++	++	++	–	–	–
Para B	1/1250	++	++	++	++	++	++	–	–	–
Para C	1/12500	++	++	++	++	++	++	++	++	+

MUTTON GROUP SERUM ABSORBED WITH CULTURES OF NEWPORT SPECIFIC.

Culture	Titre before absorption	Titre after absorption								
		1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000	1/12500
Newport ..	.. 1/500	++	++	++	++	+	–	–	–	–
Mutton ..	.. 1/12500	++	++	++	++	++	++	++	++	+
Para B ..	.. 1/500	++	++	++	++	+	–	–	–	–
Para C ..	.. 1/125	++	++	++	–	–	–	–	–	–

The experiment recorded below demonstrates the interchangeability of the non-specific sera prepared, as shown in the previous experiment, by the absorption of a group serum of "Newport" with a culture of specific Newport.

A pure non-specific agglutinating serum was examined with a broth culture of specific "Newport" and found to be incapable of agglutinating it even in the low dilution of 1/5. Its titre for the group organisms was 1/500.

A *B. paratyphoid* B group serum was then absorbed with cultures of a non-specific "Mutton":—

Culture	Titre before absorption	Titre after absorption							
		1/25	1/50	1/125	1/250	1/500	1/250	1/2500	1/5000
Newport ..	1/5000	–	–	–	–	–	–	–	–
Mutton ..	1/12500	–	–	–	–	–	–	–	–
Para B ..	1/25000	++	++	++	++	++	++	++	–
Para C ..	1/5000	–	–	–	–	–	–	–	–

Equal quantities of the pure non-specific "Newport" serum and the absorbed *B. paratyphoid* B serum were now mixed together and tested against the same cultures. The mixing being equivalent to diluting each serum one half.

	1/25	1/50	1/125	1/250	1/500	1/1250	1/2500	1/5000
Newport ..	++	++	++	++	+	–	–	–
Mutton ..	++	++	++	++	+	–	–	–
Para B ..	++	++	++	++	++	++	+	–
Para C ..	++	++	++	++	–	–	–	–

Other experiments of this type were devised and they all gave results comparable with the one recorded above.

The following is an example of the specificity of absorption. The various strains of *B. paratyphosus* C were being examined from point of view of their trueness to type. It was found, in the case of the strains examined, that three agar slopes of that organism would entirely remove the *B. paratyphoid* C agglutinins from one cubic centimetre of a standard *B. paratyphoid* C serum in two hours. When one came to examine *B. paratyphoid* C strain East Africa difficulty was experienced. The titre of the original serum was as follows:—

Para C 1/12500, Para B 1/1250, "Mutton" 1/1250, "Newport" 1/1250.

After absorption the titre for *B. paratyphosus* C was 1/2500. The absorption was repeated twice, but the titre for *B. paratyphoid* C remained just a shade less than 1/2500. The serum was then examined more fully and was found to have lost all its group agglutinins. It was then concluded that the absorption had been carried out with a non-specific type of

"East Africa." A specific of this organism was then obtained by the usual method and the absorption repeated. The whole of the *B. paratyphoid* C agglutinins were found to have been removed.

Demonstration of the Presence of Specific and Non-specific Types in the Normal Laboratory Agglutinable Culture.

Pure non-specific "Newport" serum was diluted 1/20 and then added to the normal laboratory agglutinable culture of "Newport." Part of this was introduced into a three-inch by half-inch test tube which was placed in a water bath at 55° C. for two hours, and part made into a hanging-drop preparation and observed under the microscope. After an hour no further clumping was seen to occur, yet there were considerable numbers of bacilli not agglutinated in the field. After two hours the tube was removed from the water bath and centrifugalized at high speed for fifteen minutes. Viewed under the microscope the supernatant fluid was free from clumps, but showed numbers of discrete bacilli. Next, an apparatus—similar to that for isolating single bacterial cells—was arranged so that serum could be added to hanging-drop preparations whilst still under observation. Two drops of the supernatant fluid were then placed on a long slip which was inverted over the semi-open cell, the discrete bacilli observed and non-specific serum introduced from the pipette. No agglutination was seen after ten minutes. The second drop was then brought into the field for observation and specific serum added from a fresh pipette. Almost immediately complete clumping was seen. By macroscopic methods this phenomenon was demonstrated first by commencing with the non-specific agglutination and following with the specific agglutination, and then reversing the order.

Lability of the two types—Specific and Non-specific.

In examining this condition one started off with the first generation of each type grown from a single cell isolation, and although it is recorded at the end of this paper the actual experiments were carried concurrently with the others. The various cultures were examined with highly specific sera of both types which were correct in their reactions at a dilution of less than one-fifth.

First broth cultures of each type were subcultured from broth to broth every twenty-four hours and incubated for twenty-four hours. Immediately after the subcultivation had been made the culture was formalized and diluted to standard opacity with 0·1 per cent formol-saline. Subcultivation was carried on for twelve generations.

The original agar cultures of the first single cell isolation were examined at the end of a week at room temperature and then weekly for a period of five weeks. In view of the fact that the non-specific type was only isolated once four agar subcultures were made from the original colony. At the end of the first week all the non-specific cultures were found to be mixed, but only to the extent of one in ten. The three cultures of the specific type remained pure.

RESULTS.

Generation	Specific type Serum: Specific	Specific type Serum: Non-specific	Non-specific type Serum: Specific	Non-specific type Serum: Non-specific
1st	+ +	–	–	+ +
2nd	+ +	–	–	+ +
3rd	+ +	–	–	+ +
4th	+ +	–	–	+ +
5th	+ +	–	–	+ +
6th	+ +	–	–	+ +
7th	+ +	–	–	+ +
8th	+ +	–	–	+ +
9th	+ +	–	–	+ +
10th	+ +	–	–	+ +
11th	+ +	–	–	+ +
12th	+ +	–	–	+ +

At the end of the second week the proportion of the two types in the non-specific cultures did not appear to have changed and the specific remained pure. Successive examinations have given the same results, the only difference being that the non-specific types appear to have developed a few more specific forms. But only a few, for the proportion at the end of five weeks is only two to ten.

A rabbit was given intravenously 0·1 cubic centimetre of a formalized broth culture of the first generation of the specific type. At the end of five days the rabbit's serum agglutinated a pure specific type in dilutions of 1/500, but would not agglutinate a non-specific type at a dilution of 1/12½.

Another rabbit was injected intravenously with 0·1 and 0·25 cubic centimetre of a broth culture made from an agar culture of specific type which had been standing at room temperature for two weeks, and the agglutinin content five days after the last injection was : 1/2500 for the specific type and 1/50 for the non-specific type.

Both these animals were tested before the immunization was commenced and were found to be quite free from any agglutinins of the group under examination.

A guinea-pig of 300 grammes weight approximate was inoculated intraperitoneally with 1/10 of an agar slope of live "specific Newport." This culture was taken from the original agar slope when it had stood for nearly three weeks. The animal became ill but recovered. Five days later one quarter of an agar slope was administered. On the fourth day after the last injection the animal was killed. Pure cultures of the specific type of "Newport" were obtained from the blood, spleen, gall-bladder, intestine and peritoneum. The cultures were examined very carefully for the presence of non-specific organisms, but no positive evidence could be found. The blood serum contained agglutinins for the specific type only; the titre being 1/125.

A guinea-pig of similar weight to the above was inoculated in the same way with live cultures of pure non-specific "Newport." The animal was killed on the third day after the last injection. Cultures from the blood and spleen were found to be mixed and to contain both specific and non-specific

types. Cultures from the gall-bladder, an abscess in the liver, and the intestine contained the non-specific forms only. The blood serum contained agglutinins for both types: titre for specific organism, 1/50; titre for non-specific organism, 1/125.

In both these experiments, too, the animals were shown to be quite normal before inoculation.

It should be mentioned that although some of the cultures did exhibit the characters described by Arkwright and Goyle, and Weil and Felix, etc., one was not able to establish any direct relation between the two series.

CONCLUSIONS.

(1) All members of the Salmonella group produce two serological types of organisms, a specific and a non-specific.

(2) In the case of the "Newport" organism, by frequent subcultivation in broth, these two types have been shown to breed true for at least twelve generations. The non-specific type under normal laboratory conditions quickly develops specific types. The specific type is much more stable, and although it may, under certain conditions, develop non-specific forms, an absolutely pure culture will usually breed true.

(3) Apart from the fact that a non-specific type tends to develop a specific type of its own strain, these forms of all the members of the group are identical in their reactions and cannot be separated.

(4) Pure specific and non-specific agglutinating sera may be prepared by immunizing rabbits with absolutely pure antigens or by absorbing an ordinary group serum with pure cultures of either type. In preparing specific sera by the latter method, the group serum may be absorbed with the non-specific organisms of any member of the group and it is not necessary to use more than one member, but in the case of pure non-specific agglutinating sera, the absorbing agent must be the specific form of the homologous strain.

(5) In making use of a specific serum for the identification of an organism belonging to the Salmonella group it may be necessary to examine many colonies before finding a specific one, although usually they are more numerous than the non-specific form. In most cases the use of specific sera enables identification to be carried out more quickly and with less trouble than the ordinary absorption method.

I have to thank Lieutenant-Colonel H. Marrian Perry, O.B.E., R.A.M.C., Professor of Pathology, Royal Army Medical College, and Major C. J. Coppinger, R.A.M.C., for helpful suggestions.

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A FIELD AMBULANCE ON THE NORTH-WEST FRONTIER.

By Captain M. J. WHELTON.
Royal Army Medical Corps.

In January, 1924, I was ordered to "proceed forthwith to Chagmalai, Waziristan, and report to the Officer Commanding 64th Field Ambulance for duty."

As far as one could gather from speeches in the Legislative Assembly, the thorniest tract of the Border, Waziristan, was then "quiet," so also was the rest of the Frontier, where "normal conditions" held sway. I had received my orders during the so-called cold weather. The climate in the United Provinces, where I was stationed, was then perfect, or as nearly perfect as one can get in this wicked world. From a cloudless sky the sun shone brilliantly during the day, and in the evening there was a sufficient nip in the air to make one appreciate a fire.

At that time of the year the plains of India are at their best, and provide good sport, such as pig-sticking, shooting and hunting.

There is, too, a stillness and calmness in those vast spaces that has a fascination all its own.

I had met many officers who had served in Waziristan, and their conversation about life on that part of the frontier had always been of a disparaging nature. With anything but cheerfulness, then, I left the pleasant cantonment in which I was stationed, and journeyed north-west on the Punjab Mail, changing first at Lahore, and at many stations subsequently. I was quite familiar with the country I saw between Ambala and Rawalpindi, as, only a year previously, I had marched along the Grand Trunk Road, which runs close to the railway line all the way. Day after day, when on that march, I saw the peasants at work in their fields. They were poor, kindly souls, bent with toil and ever oppressed by the possibility of a poor harvest. Around Lahore is the Land of Kim, and I saw the gun, Kim's gun, when on that march. Many consider "Kim" to be Kipling's masterpiece. In it he has made his characters express the Soul of the East—infinite patience and passive acquiescence in fate.

I saw again, but this time from a carriage window, some of the big irrigation canals that have converted a one-time barren desert into a productive corn land. It was late in the afternoon when the "Mail" reached Campbellpore, where I had to change. After a few hours' wait in the almost deserted station the train started for Daud Khel.

For some reason there was an unforeseen stop at the small station of Garda Zai, due, as far as I can recollect, to a breakdown ahead. The night was one of those cold ones common to Northern Punjab during the winter. The place was dimly illuminated by a few oil lamps and it was raining. I

wanted to find out if the delay would prevent my catching the boat train from Daud Khel to the river bank, so I went to confer with the station master. I found him in an attitude of placid content, squatting on a stool. He was muffled up to the eyes, though the room was not cold. What with the heat and smoke from a wood fire and the smell from an oil lamp that, as usual, was not burning properly, the place was warm and stuffy. Having partly unwound his head-dress, a muffler-like creation, so as to uncover his mouth, he replied to my question, "But, sir, I do not know, it is not my department. Perhaps the Indus will not be crossed to-morrow as, without doubt, there has been too much rain in hills."

To enhance this rosy forecast he added another possibility: "Moreover, the boat will doubtless be late to catch train on other side of river."

Then, because neither of us had anything to do until the train was allowed to start, we fell to discussing various matters. I have a vague recollection that he proved that Bengal was the cradle of Indian genius. "We Bengalese," said he, "have first-class *brain*." I pointed out that grey matter alone would not win battles. "But, sir," he argued, "we do not make war, we are not fighting race, we enjoy fruits of peace of British Government." His outline of a policy to solve the Border riddle was interrupted by a request for his dominating personality at the telephone. As the message had to do with the immediate starting of the train, I was unable to hear the full details of the scheme he proposed. Part of it was, I remember, to give every man in India a rifle and send him to the Frontier. I have no doubt that this would solve the problem, but in a way pleasing to the tribesmen.

At about 5 a.m. we reached Daud Khel. At the junction there, connexions are made with the rail services to the left bank of the Indus. It was still dark when the train arrived in the station and the oil lamps had gone out or had been blown out by the wind.

The only light in the place came from a small office. In it I found one of the lesser luminaries of the railway staff, sitting at a paper-littered table and engrossed in correspondence. He was sure that the boat would cross that morning, but was unable to inform me when I could hope to reach Tank, the principal military centre *en route* to Waziristan. "Perhaps to-day, perhaps to-morrow, I do not know," was what he said. I had to be content with this vague answer, as, having no servant, I had to hurry back to my carriage to watch my kit being unloaded. The sacredness of private property is not fully understood in this part of the world!

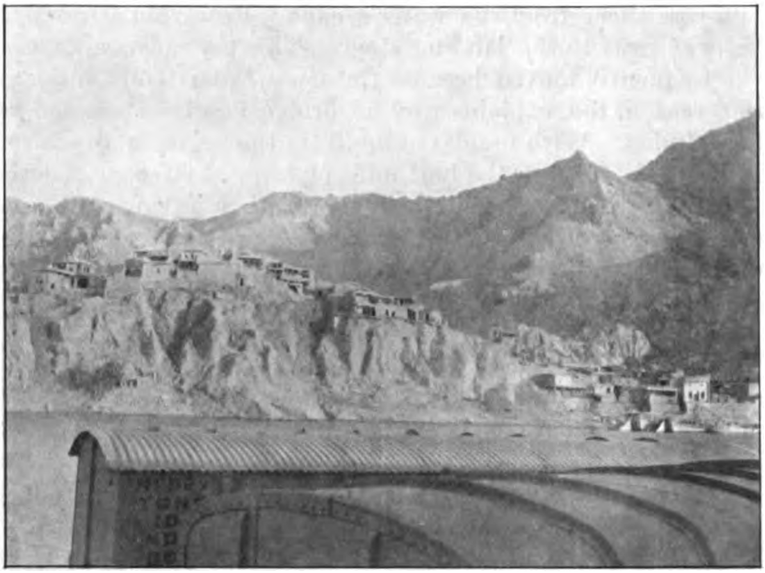
Waziristan is not popular with servants and Mohammed Yussuff had refused to come with me at the last moment before starting. He gave the usual excuse of his class to cloak his dislike for frontier life, family illness. The Civil Surgeon's khansamah (butler) had been consulted and had pronounced the sick relative as "dangerously ill." With the aid of a fellow-passenger's servant who had not, presumably, such an obliging family doctor as mine, I got my belongings into the boat-train. After a short

journey Mari Indus was reached. In the dim morning light I could just see the river. Its near bank was a wide sandy waste, and on the other side high hills rose sheer from the water's edge. From Mari Indus a narrow gauge railway runs to the landing stage. This toy railway, as it is called, has to be frequently moved because the river bed is constantly changing. The same reason, too, explains why no bridge has been erected over this part of the Indus. With much puffing from the engine and a false start or two the train jolted over the half mile of sand that separated the broad gauge from Mari Ghat. There it stopped with a jarring suddenness, and my carriage was immediately surrounded by a crowd of half-clothed coolies. They were tall, dark-haired, wiry fellows, a foretaste of the types met with in the lands beyond Indus. They squabbled with each other for the privilege of taking master's baggage aboard the ferry-boat "Jhelum," which was moored close by. Each man wanted to carry something and pounced vulture-like on any bit of kit he could grasp. The result was a great division of labour, entailing proportionately heavy distribution of bakshish.

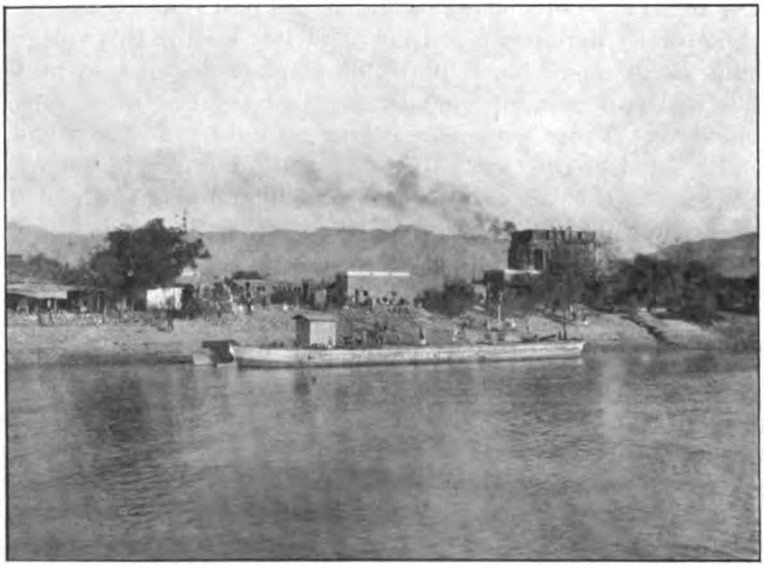
The boat crossed diagonally, partly carried by the current towards Kalabagh Ghat, the landing place for the station.

The river-side village Kalabagh when seen, as I first saw it, on a wet morning from the deck of a ferry boat, was not attractive in the least. It consists of rows of mud and stone houses built along the bank, rising in tiers one above the other over the lower slopes of a bare hill. It is a triumph in the science of makeshift architecture. The reader probably knows the usual type of house that graces a small Indian bazaar. Such a structure is solidly built compared to the variety seen in this village. Here is one built partly on rock and partly on planks supported by props which are made from two or more rough poles tied together with rope, Heath Robinson style. These props are never straight, and the whole edifice leans to one side like the tower in Pisa. Put a number of such creations in rows one above the other at the foot of a high hill, give them flat roofs and plaster the walls with mud, and you have an idea what this village looks like—an engineer's nightmare. With poetic imagination only could it be endowed with beauty. Possibly after many weary months in Waziristan it might appear artistic in contrast to the walled-in villages seen there. My travelling companion, a veteran of the Frontier, said that it reminded him of Rhine-side villages. But they have the grape, lightener of life's worries and burdens, whereas Kalabagh produces the most mundane of necessities—common salt.

The river forms the natural boundary between the Punjab and the North-west Frontier Province or trans-Indus part of India. Throughout practically its whole course it runs close to the mountain walls that are India's barriers on the north-west. It separates the arid stretches on one side from the rich plains of Hindustan on the other. It was still raining and the hilltops were enveloped in mist and cloud when I landed on the right bank, that is in the North-west Frontier Province.



Kalabagh Village, from train ferry-boat. Photograph by Major R. F. Bridges, R.A.M.C.



Kalabagh Ghat and Station. "The jumping off point for Waziristan." Photograph by Major R. F. Bridges, R.A.M.C.

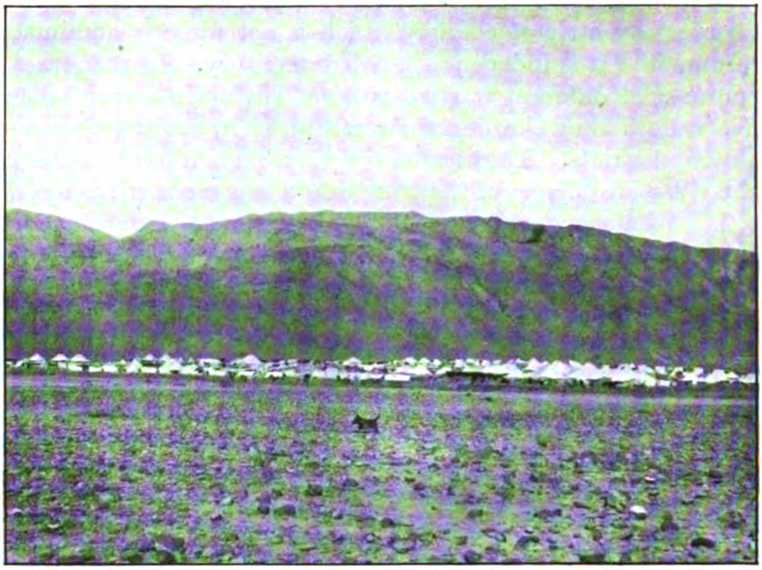
This Province consists of five settled districts, Hazara, Peshawar, Kohat, Bannu and Dera Ismail Khan. Beyond them and between the Afghan border is a strip of country which is not directly administered by any government. It is independent tribal territory. In that tract of land dwell a number of different warlike tribes. Living in barren hills and unproductive valleys they eke out their resources by raiding the more prosperous settled districts. They have even been known to cross the Indus to ravage the riverside villages of the Punjab. Their mode of life has endowed them with an independent spirit and has produced a physique that can withstand great hardships and fatigues. Being Moslems, and therefore co-religionists with the Afghans, they are susceptible to the political currents

R.P. Troops. Marching to position. Photograph by Capt. M. J. Whelton, R.A.M.C.

of that country. This explains why the Frontier was in a ferment of unrest during the third Afghan War in 1919. By nature they are fanatical, and at any moment an outstanding personality might unite them in a Jihad (Holy War). Mustering on the whole frontier over 120,000 fighting men, well equipped with modern rifles, they constitute a constant menace to the peace of India.

In this trans-Indus country, too, are the great passes or gateways from Central Asia to Hindustan. From time immemorial wave after wave of Assyrians, Greeks, Persians, Pathans, Tartars and Afghans have swept through these portals carrying terror and destruction wherever they went.

Mahmud of Ghazni and Timur the Lame were specially ruthless invaders. Alexander the Great came through the Khyber Pass, but his



Chagmalai Camp. Photograph by Mr. Marcoolyn, I.A.S.C.

At the water-point, Chagmalai Camp. Water-testing on the right, tribesmen-owned camels in the background. Photograph by Major R. F. Bridges, R.A.M.C.

subsequent conquest of the country was not marred by the barbarism that characterized the Oriental invaders. As his army was unable to withstand the fierce heat of the Punjab he was forced to return homewards. The conquerors who have made their influence most felt were the Moguls. They founded an empire of unparalleled splendour, which reached its zenith during the reign of Shah Jahan. A measure of his greatness may be gauged from the buildings he had erected. But the Moguls, like so many other dynasties in the East, gradually declined in power. At the same time the Sikhs attained importance. Their empire extended over present day Punjab, and it was sufficiently powerful to send many expeditions to conquer and control the lands beyond the Indus. This policy we inherited after the last Sikh war, when their territories came under our sway. Ever since those days the tribesmen of Waziristan have been the most turbulent irreconcilables of the frontier. Their repeated misdeeds have called for punishment, and have led to the launching of many campaigns against them. Military operations in the past were beset with great difficulties, chief of which was the transporting of supplies through the then roadless lands that lay beyond the Indus. Now, however, a narrow-gauge line links up the river bank at Kalabagh with the military bases situated on the confines of tribal territory.

Kalabagh is the main railway centre and jumping-off point for Waziristan. It is impossible to take the wrong train from there. Once and once only in the twenty-four hours does the Tank "Express" leave the station. It was ready to start by the time I had distributed backshish among the many coolies who had piled my kit into a diminutive first-class carriage. The guard, however, was obliging enough to hazard that "No doubt departure could be delayed until sahibs had food." So my fellow traveller and I repaired to a mud-plastered building marked "Refreshment Room." It provided the usual "eggs to order," "half-boiled," "three-quarter boiled," or "full-boiled" according to individual taste. At the marmalade stage we were informed by an emissary from the station-master that the train would start in two minutes. My companion, who had an infinite experience of the East, was not perturbed at the imminence of departure, confidently asserting that "it couldn't go without us." Not wishing to tempt the gods I hastily finished my breakfast and got into my compartment. But I need not have worried, as the guard did wait until my confrère had rejoined me. Then we rumbled out of the station, past galvanized iron sheds, mud and brick offices and stores depôts. The hills on the right gradually receded, and on either hand stretched a desolate plain. Here and there a stunted tree relieved the dull monotony. For hours we travelled over a featureless land, with occasional stops at small stations. They consisted of squat huts built on straight lines of a uniform and monotonous standard. The water channels were filled with chocolate-coloured water. Here and there were muddy pools and the ground was sodden. "What a climate!" "What a country!" exclaimed

my companion. He was returning from leave in the South, and his mind ran on sunshine-filled days and palm-groved river banks.

It was nearly five in the afternoon and getting dark when we reached Tank, a barbed-wire enclosed camp or cantonment, whichever you prefer. A unit accountant would style it a "peace time station" in the Waziristan district, and he is an authority on such matters. The Military Accounts Department dominates all spheres of life and activity in the Waziristan Force. Everything, down to the sepoys' rations, is valued on a rupee basis. So the expression "peace-time station" robs one not only of romance, but also of the little concessions one expects on the Frontier. The important point for me was that shelter and accommodation were to be got there. Over the rest-camp mess was a notice board bearing a message that promised good cheer—"Ye Olde Tank Arms, S.S.O., Proprietor and General Manager." And it lived up to its promise, for though it did not provide a potman or tankards, or "mine host's canary wine," it provided their Eastern equivalents, *mutatis mutandis.* Next day, as if to make amends, there was brillant sunshine, with a clearness in the air that did much to counter the dreariness of the country. To get to my destination, Chagmalai, required a two days' road journey, for which I was given a Ford vanette for the first stage.

Tank is situated in the Darajat Plain, the name given to the flat country that lies between the Indus and the Suleiman range of mountains. In the clear atmosphere their slopes were seen to rise abruptly from the level ground. Towards them I motored over the metalled road. Within the first mile there stands a walled-in village, whose lines express prevailing conditions of life. Inside the walls are several high square towers, with loopholes on their business sides and observation posts on their flat roofs. From these commanding positions the tribesmen are able to watch their cultivated fields and grazing lands. Sometimes on account of local scarcity the herdsmen drive their flocks to remote pastures. Such an occasion offers a golden opportunity to the cattle raiders from the poverty stricken hill villages. Occasionally a headline may be seen in the daily papers worded after this fashion: "Daring cattle raid on the Frontier, four villagers killed." Underneath this is a short summary of what has taken place, and the average man in the plains but glances at the account given. He passes on to something that is of more interest to him, for he is not affected by the happenings in these primitive lands. Nor does one consider a raid an inexplicable occurrence after seeing Waziristan. It is but an expression of the struggle for existence by a method sanctified by tradition and necessity. Ordinarily, after the day's grazing, the cattle are driven inside the village walls and are shut up in their byres till the following morning.

Along the roadside are stretches without a trace of vegetation. This is due to the presence of mineral salts which show on the surface as a thin layer, like hoar frost. Their absence and the presence of water

are the factors that govern the agricultural value of land along the Frontier. After motoring for about ten miles Kaur Fort was reached. Opposite it are put in position the wire obstacles that "close" the highway for eighteen out of every twenty-four hours; during the remaining six hours the road is "open" for everyone, whether going up or down, whether on leave or business bent. From here onwards it is guarded during the "open" hours by infantry units, or "R.P." (Road Protection) Troops, as they are styled. Everything was peaceful and quiet as I motored along; so quiet indeed as to give the impression that sepoys and Lewis gunners were taking part in a peace-time manœuvre. A little beyond Kaur the road touches the edge of the plain, which it follows, ascending and descending the many small foothills that flank the level ground. Grazing on these little slopes were flocks of sheep and goats. Their herdsmen were ragged cheery-looking ruffians, whose faces and bodies were grimed with the dirt of ages. The rifle and cartridge belt that each one carried added a touch of the bizarre to what is regarded as a peaceful occupation. Instinctively one associates a shepherd with green fields and the simplicity of rural life. Artists paint him in a background of lush meadows and tall trees and give him a harmless expression. But in this inhospitable land a tribesman without a rifle would be as unusual an apparition as little Bo-peep.

About nineteen miles from Tank is Manzai, another barbed wire camp, an embryo cantonment. The road ploughs straight through, bisecting this "peace-time" station, where the playing pitch has to be piquetted before one can venture outside the wire for football or hockey. The road, after leaving the camp, still follows the edge of the plain. It crosses over many small watercourses and dry nallahs before reaching the next camp, Khirgi. It, too, is built on the same lines and has similar attractions to those already passed. In addition it is the terminus of the narrow-gauge railway, our link with Kalabagh and so with the happier lands to the south of the river. The first stage of my road journey was completed when I arrived at this camp. Behind it are bare mean hills and in front stretches the dreary plain. It is strange how the cheeriness of a mess varies with its surroundings. The more dismal the country the more cheerful the mess, and the Medical Mess at Khirgi was no exception to the rule.

I started early next morning (suffering from this cheeriness) in another of the products of Mr. Ford's ingenuity, as the journey up the line is done in relays of cars. Immediately beyond the camp the road passes the boundary between British India and Waziristan. It is but a tentative boundary, which may be altered at any time, depending on whether a "forward" or "backward" policy becomes the accepted method of dealing with the territories between India and Afghanistan.

Just beyond the boundary the road leaves the edge of the plain and sweeps straight into the zone of hills that flank the Takki Zam river.

This stream it follows, but at a much higher level than the rocky bed, except where it drops down to cross and recross over bridges. When, during the road construction, very difficult stretches of rock were found on one side, the engineers found it cheaper to bridge the watercourse and follow the line of lesser resistance. Dominating the river valley are piquet posts. Some are low down and close to the road, others are high up, crowning wind-swept pinnacles. Possibly on account of the cold, which was Arctic-like in its intensity, there was no tribesman to be seen as I motored along. Gradually the road separated from the river valley, and ran over a relatively level stretch of ground. On this open space stands Jandola Fort. Opposite it is a military cemetery. The many white crosses make a sad record of "regrettable incidents" that have occurred in the neighbourhood, "But things like that you know must be." Here, a few miles beyond the Frontier Bar, sleep some of our own kinsmen, for

> "Never the lotus closes, never the wildfowl wake
> But a soul goes out on the east wind that died for England's sake."

Many of the units who spent part of their Frontier tour on this border-side outpost have adorned the walls of the Fort Mess with their regimental crests. Many, too, have left their names on the marble crosses that mark the last resting place of some of their officers.

This road from Jandola onward follows the Shahur River, zigzagging in and out along the hillsides. It switchbacks up and down the many small elevations and bends at very acute angles. It is as contorted as a corkscrew, but not as regular. On all sides are tangled masses of rugged hills and ranges of bare rock of every imaginable size and shape. Everywhere are stones and boulders, and the landscape is utterly devoid of vegetation. As I motored along, a land unfolded itself that was dreary beyond all conception. The mountains that limited the horizon on the north-west were covered with snow, and from their direction a cold wind was blowing in fitful gusts, moaning dismally down the river valley, whistling shrilly through arid gullies and yawning gulches.

Overtopping a crest there suddenly came into view the white tents of Chagmalai camp. The stretch of level ground on which it stood was roughly triangular in shape, one side bounded by a nallah, another by the Shahur River, and the third by a rocky sierra. Rising from the ground just beyond the nallah and river were towering hills, on the crests of which were perched piquet posts that commanded the camp site. The level stretch was littered with rounded dark coloured stones. Sometime, in ages long past, this area must have been under water, and some convulsion of the Earth's surface has placed it in its present position, a cuplike depression with dominating hills all round. Here and there in the mosaic of stones were bushes of camel-thorn.

As I motored onwards the perimeter wall and the belts of barbed wire that surrounded the camp came into view. Here, at my destination, the road petered out. It had led me from Tank past one landmark of civiliza-

tion at Khirgi, the terminus of the railway. Immediately afterwards it had taken me past the Frontier Bar, and had led me through Yaghastan to this point, its end—the farthest spear-point of civilization. But the line stretched to a point some six miles further up the river. There, out in the blue, were encamped sappers and pioneers who were working at full pressure to extend this highway a little further through the wastes of Waziristan.

It had taken nearly five days to travel to this camp at the road's end. The earlier stages were through a land that had been the scene of numberless invasions. Dynasties that have ruled it have come and gone, leaving scarce a trace of the greatness that once was theirs. Hindoostan no longer resounds to the tread of barbaric invaders, but few of her inhabitants realize that this happy state is due to the ceaseless watch and ward on her Frontiers.

As I passed through the wire I directed the driver to the row of tents over which were flying, side by side, the Union Jack and Geneva Red Cross. After reporting to the Officer Commanding the 64th Field Ambulance, I came on the strength of a medical unit that had already seen over four years continuous service in Waziristan. Its history would be a record of more than ordinary interest, and would bid fair to be a story of Frontier Medical Administration embodying to the fullest degree the ideal expressed in the Corps' motto "In Arduis Fidelis."

THE BIRTH OF A CORRESPONDENCE CIRCLE.

By Major M. B. H. RITCHIE, D.S,O.
Royal Army Medical Corps.

EMANATING from Major H. S. Blackmore's letter in the June number of the Journal, the idea of correspondence as a means of instruction has appealed to many officers, and it is gratifying to find that those who have expressed their interest in the scheme are not limited to the junior ranks of the Royal Army Medical Corps. The response to the letter in the August number is, on the whole, satisfactory. Several replies have been received, sufficient to justify the impression that a circle of medical officers can be launched.

The objective of the circle is to impart information and to discuss matters of military medical moment; to make the scheme a success, it is necessary that anyone who possesses an idea, and anyone who has a conundrum to solve, should give the circle the chance of developing the idea and solving the conundrum. Modesty need not be outraged, for names can be omitted; absence of high literary standard is no bar; notes need not be typewritten, both sides of the paper can be used; a pencil has equal rights with the pen. It is the ideas and the conundrums that are wanted; let us have something to think about and the circle will flourish.

As regards the method of operating the circle, individual inquirers can be answered direct; perhaps they in turn will assist in the elucidation of other inquiries. Epitomes of opinions on definite topics of general interest, and notes on subjects that have been dealt with, will be sent for publication to our Journal as and when sufficient material is collected. Now to some topics which have been under discussion.

THE PROFESSIONAL AND THE ADMINISTRATIVE.

WANTED, A POLICY.

When we get together and talk "shop"—a group on the ante-room fender seat—a subject that is frequently discussed is the vexed question of administrative versus professional duties for the higher ranks. In the group may be a specialist possessed of a high qualification, result of much expenditure, mental and monetary; he may ask what good it has done him, instancing the case of an officer whose specialist qualifications were a hindrance to his chances of honours or advancement in the late war. Such cases have occurred. Another on the fender seat may bring up the curious fact that a senior officer—or a specialist—is, to put it mildly, not in the least thrilled at the prospect of seeing the morning sick. Can it be that seeing the morning sick is *infra dig.* compared with seeing the morning correspondence? Are memoranda superior to men?

In dropping scalpel, test-tube, or stethoscope, in a wild rush to seize the telephone on the office table, are we, or are we not, pursuing an administrative will-o'-the-wisp ?

Here is a subject that requires opinions from officers of every rank. In it is bound up much of our future efficiency; on it may depend our recruiting; by it may be judged the position that we hold in the eyes of the general public. Much can be said in favour of an upward administrative trend; much can be said also in support of professional duties being carried on by specially gifted senior officers. The civil side of the profession is not quite analogous to the military; again, the profession of medicine cannot be organized on lines wholly identical with the profession of arms. Have we got to scrap our old, and indent for new conceptions?

Is Chlorination Fool-Proof ?

A correspondent inquires in what manner purification of water by chlorination is considered " far from fool-proof in practice," and why there should be any special scope for us in the direction of improving this method of treating water on field service.

As the columns of this journal will demonstrate, much research has been done on this subject of late, but it has been confined principally to the second part of the process, which is chlorination. The point which impresses the onlooker is that much of the success of the process depends upon *clarification*. It is possible that some more efficient chemical disinfectant may be discovered, in which case bleaching powder will be discarded; but clarification, like the poor, is always with us as a difficult problem. Muddy, dirty water, often inevitable under conditions of active service, must be adequately clarified, or soldiers may resort to untreated waters. Clarification thus seems to be a very important part of the process, and when properly accomplished removes not only suspended matter but also bacteria.

The four water carts once allotted to a battalion have now been reduced to two ; and there are the small units and the detached parties to consider; whatever war establishments there may be, small detached parties and units crop up on service, and the essence of disease prevention is thoroughness; every individual must be protected. Portable clarifiers for small units were provided during the late war, but these might be made lighter and more fool-proof.

There appears to be considerable scope for us in this direction. The experimental horizon of the medical officer is not limited by the four walls of a laboratory ; nor need the experimenter be a scientist. The tools in a garage in place of the test-tubes in a laboratory, he who takes delight in the " innards " of an old Ford or a motor bike has as much opportunity for experimenting and devising as the scientist. In the appliance of modern military hygiene there is a wide field for the medical officer with a mechanical turn of mind. Why leave these matters to the engineer, when we know best what is required ?

But, it may be said, anything of this sort will be done at the College. Perhaps this is correct. Good men and able scientists though they be, the workers at the College have no more experience of water carts and water problems on field service than you. And the College is in London, while you are in a military station among the troops. It is you who are the better placed for the work, which resolves itself into practical application of the chlorination principle to actual conditions in war. The hardest-worked of us get a little leisure; cannot some of it be devoted to one of the numerous problems of war hygiene, such as water purification, or must everything be left to the College? Why not do a bit of thinking for ourselves, and help the old College along with some of the sound ideas that many most assuredly possess?

The Brain of the Corps.

A College, a War Office, a high command, in all three cases it is necessary to obtain a clearer conception of what they are humanly capable of doing in the matter of military medical progress. Able, hard-working staffs must be assisted by the ideas, suggestions, results of work, furnished by the Corps as a whole; a closer *liaison*, an increased supply of mental raw material, as it were, will result in an increased output. An administration cannot be creative all the time; it must be co-ordinative, ready to exploit and develop ideas furnished by the administrated. "Picking another fellow's brains," you may reply; but in the Corps there must be but one big brain to which all should contribute. Each one of us, if we only care, can assist the Corps brain. On us now rests the responsibility of maintaining the efficiency built up in the last two decades, and of preparing the way for the greatly increased duties that must inevitably fall to us when our potentialities in war are better recognized.

"Good Losers."

Let us forget our "moan" for a while. Disgruntlement has not helped much; let us now try the effect of collective work. We have got to think bigger. Ours is a relay race; let it not be said that those in the lap before us have done better; in spite of severe handicap let us go "all out" in a sporting effort, and set an example to the next relay. Never let us forget that we know how to be good losers.

Information Regarding Study.

One way in which a circle can be of use to officers is in the collection and distribution of notes and hints for those who contemplate sitting for examinations for the higher degrees and qualifications. It is hoped to obtain information of this nature for the benefit of any officers who may desire to know about the conditions for taking these degrees or qualifications, and Major C. M. Finny has kindly contributed the first of what may eventually comprise a complete series. His article on how to become a Fellow of the Royal College of Surgeons of England is given below.

Practical Hints on how to Become a Fellow of the Royal College of Surgeons of England.

By Major C. M. FINNY, M.B., F.R.C.S.
Royal Army Medical Corps.

Information on the above subject may conveniently be considered under the following headings:—

(*a*) Conditions imposed by the College.
(*b*) Facilities for study in the Army.
(*c*) Hints on the work necessary to pass.

(*a*) *Conditions Imposed by the College.*

The examination consists of two parts, generally spoken of as the "primary" and the "final." Before presenting himself for the final, a candidate must be qualified, over 25 years of age and either a M.R.C.S. or have attended the surgical work of a recognized hospital for one year after becoming qualified.

Before the war surgical work in a military hospital was not sufficient to satisfy this last condition; but the College has become more lenient, and recognition may be given for surgical work in a war hospital. If such recognition is required, it is wise to make certain by writing to the Secretary, R.C.S., The Examination Hall, Golden Square, Bloomsbury. The time spent attending a civil hospital in London during the senior course at the Royal Army Medical College may be counted. A certificate of attendance should be obtained from the hospital Dean.

(*b*) *Facilities for Study in the Army.*

Though a certain amount of work can be done wherever one is stationed the examination is difficult to pass without attending hospitals and "grind" classes. The War Office is usually willing to help in this respect by stationing in London officers, who wish to work for the Fellowship.

For the second part of the examination, the best opportunity for study is provided by the special course in surgery following the general senior course at Millbank. This surgical course lasts about six months and consists of the Fellowship "grind" classes at the London Hospital. As it entails no other duties it provides unrivalled opportunities for study—better, in fact, than most of the civilian candidates can aspire to.

(*c*) *Hints on the Work Necessary to Pass.*

The fellowship examination consists of two parts: (1) the primary in anatomy and physiology, and (2) the final in surgery, applied anatomy and pathology. There is a popular idea that the primary is the more difficult of the two, but this is not the case. Doubtless it seems more difficult at first for a qualified man to rub up his anatomy and physiology than to study a subject in which he is already engaged; but, apart from that, the standard of the final is much higher. Anyone, including a medical

student, can sit for the primary, and often as many as thirty per cent are let through. But in the final rarely more than twenty-five per cent of the candidates pass, and only individuals with sufficient brains to pass the primary can compete. Further, it is a common thing to pass the primary at the first attempt—this has been done by practically every R.A.M.C. candidate in recent years—but it is the exception for a man to pass his final without more than one effort.

(1) The primary consists of a paper and *viva* in both anatomy and physiology. A very deep knowledge of the subjects is not required, but the candidate must have a thorough and accurate grasp of the ordinary pass anatomy and physiology. In addition, he should be able to describe the various bones fully and accurately, and have a grasp of embryology and comparative anatomy. The ordinary textbook, such as Halliburton's, gives most of what is required in physiology, but it is wise also to be familiar with the details of cutting and staining histological specimens for the microscope.

As a question is often set on some recent article in the medical press, it is wise to look up any such article which may have been published during the previous year.

(2) Final examination.—This consists of surgery, surgical pathology and anatomy. There is only one paper, which lasts for four hours, with a rest at half-time. The remainder of the examination is clinical, and *viva voce*, with the exception of the major clinical case, which is written up after examining the patient.

The only really difficult parts of the examination are the paper and the "spot" cases. The paper gives the brilliant man his chance of scintillating. The questions are not usually difficult in themselves, but a high standard is expected, and a knowledge of the more out-of-the-way points is useful though not essential.

The pathology in the paper is not deep—no deeper than what one finds in the ordinary textbook of surgery.

The other difficult part is the twenty minutes spent at the "spot" cases. All the rarest and most peculiar cases are collected from the various London hospitals and the candidate is expected to diagnose at least five or six in the time—the more the better his chances. It is a distinct strain to be shown in succession morbid conditions which one may have never seen before, and be expected to give a diagnosis; but fortunately, in the more obscure cases, the examiners are often not agreed on a diagnosis themselves, and so are satisfied with an intelligent guess from the candidate, particularly if he can back it with arguments.

The remainder of the *vivas* are no more severe than an ordinary pass examination as far as questions go, but as seventy-five per cent have got to be "ploughed" the marking is stiffer.

The amount of work necessary to pass the fellowship examinations naturally varies with the individual, but on the average two years is

ample. There is no necessity to "grind" for the primary, though it is undoubtedly a help, particularly for the physiology. For the final it is almost essential to attend "grind" classes at a London hospital, though some of the "grinds" by correspondence are a help for the written part of the examination. The chief value of the hospital classes is that it gives one a chance of seeing out-of-the-way cases, and of arriving at a diagnosis and line of treatment which may be criticized before the rest of the class. A man who is able to keep his end up when being "ragged" before his class-mates will not be bluffed into changing his mind by any examiner.

There are, however, two cautions I would like to emphasize. (1) The "grind" class often teaches unnecessary information, and (2) it tends to make the candidate feel once more a medical student.

It is a waste of time to learn up details of obscure diseases or ultra-modern treatments. The examiners are general surgeons who are not interested in such things and dislike being taught by the examinee. This applies particularly to pathology. The "grind" class at one celebrated London hospital includes a series of lectures by the Professor of Pathology. From an academic point of view they are doubtless excellent, but to assimilate them is laborious, and to reproduce them during a *viva* would probably be fatal.

The candidate must remember that he is a surgeon, not a medical student. He has a right to his own views of a case, provided that they are based on rational deductions. In the matter of treatment he will get little credit for describing complicated operations devised by brilliant Continental or American surgeons, which he would not attempt himself. He will score many more marks by saying what he would do if the case were one of his own patients and dependent on him alone for treatment. This attitude of mind is easy for the Army surgical specialist.

In short, the College of Surgeons does not wish to confer its Fellowship upon brilliant medical students, but upon sound surgeons who know their work and can treat their patients efficiently on orthodox lines.

AN EXAMINATION OF TWENTY STRAINS OF VIBRIO ISOLATED FROM CHOLERA CASES.

By Major W. W. PRATT.
Royal Army Medical Corps.

The present work was undertaken at the suggestion of Lieutenant-Colonel Marrian Perry, R.A.M.C., with a view to establishing the serological identity of a number of strains of cholera vibrios. These strains were collected by Lieutenant-Colonel Perry, and were all isolated from typical cholera cases.

Particular attention has been paid to the serological reaction of these organisms as this plays an important rôle in their identification and has been the subject of much recent work. Before proceeding further it may be well to consider the results of some of this work, which are somewhat confusing.

Most authorities state that the true cholera vibrios form one uniform serological group. There are, however, a large number of so-called paracholera organisms which form different groups. These latter have been isolated from cases of mild cholera, and also from the acute and fatal disease. Mackie [1] finds that they fall into twenty groups all serologically distinct from one another and from that of true cholera.

Certain fallacies also exist in the application of the agglutination test as may be gathered from the following results. Dr. Craster [2], working with vibrios isolated from water in New York, came to the conclusion that certain true cholera vibrios lose their agglutinating property with true cholera serum. He found that this property was restored after the vibrio had been passaged through the guinea-pig. He further stated that no vibrio could be regarded as truly saprophytic until so passaged. Greig [3] isolated many cholera-like organisms from water in Calcutta. All of these were serologically distinct from the true cholera vibrio on isolation, two of them after passage through rabbits became agglutinable with cholera serum. Douglas [4], studying the serological reactions of true cholera vibrios found they formed one group but that certain paracholera vibrios may acquire the property of being agglutinated by true cholera serum.

Present Work.

All the cultures were examined with regard to the following characteristics: Morphology and Motility, Biochemical Reactions, Hæmolytic Power, Serological Reactions.

Morphology and Motility.

All the strains were actively motile. Preparations were made and stained by Loeffler's method to show flagella. I am indebted to Dr.

Mervyn Gordon for a supply of mordant which gave very good results. In shape and size the organisms varied considerably but all were consistent in showing only one long terminal flagellum.

Biochemical Reactions.

These call for no special comment; lactose, glucose and mannite were fermented by all with the production of acid and no gas. No change was produced in milk or dulcite.

The cholera red reaction was given by all.

Gelatin Liquefaction.

In every case a small cup of liquefaction about a quarter inch deep was formed on the third day of incubation at 22° C.

Hæmolytic Power.

Greig's [5] technique was used in this test: 1, 0·5 and 0·1 cubic centimetre of a three day old broth culture being tested for each strain: all the strains failed to hæmolyse rabbits' red cells.

Serological Reactions.

Dreyer's technique was employed for the agglutination test. Agglutinable cultures were prepared from nutrient broth of reaction pH 7·4, some of the emulsions showed signs of flocculation when the original broth culture was diluted to the required opacity with normal saline. For this reason all the broth cultures were diluted with an equal quantity of distilled water, 0·1 per cent formalin being added. This method gave stable emulsions. The tubes were read after two hours' incubation at 55° C. in a water bath, the dilution of the serum showing standard agglutination was taken as the end point.

An agglutinating serum was prepared by inoculation of a rabbit with one organism *Vibrio cholera* Calcutta I. Four intravenous injections of a killed broth culture produced a serum of a titre 1 in 5,000. The autogenous organism and all the other strains were tested against this serum.

Table I shows the results of these tests.

Comments on Table I.—Only two vibrios agglutinated to full titre; six of the remainder showed no agglutination in dilution of 1 in 25 upwards, seven agglutinated to only 25 per cent, or under, of the full titre. The six non-agglutinable strains were subcultured daily into broth for three weeks in order to determine if their inagglutinability was permanent. When tested again with Calcutta I serum after this period, all except Laru Tadu showed no change.

Laru Tadu now agglutinated in a dilution of 1 in 2,500, 50 per cent of the full titre. As it was considered possible that the five remaining non-agglutinable strains had lost certain properties by continuous growth on artificial media, it was decided to passage them through animals. Each strain, except Armstrong, was passaged through three mice, Armstrong

through two only. All the strains were quite avirulent to other animals, after passage each strain was again tested with Calcutta I serum. The tubes were read after two hours and also after twenty-four hours' incubation in the water bath at 55° C. None of the cultures agglutinated with the serum in dilutions of 1 in 25 up to 1 in 25,000.

TABLE I.—Serum for *V. cholera*, Calcutta I.

Organisms	Dilutions of serums										
	1/25	1/50	1/125	1/250	1/500	1/1,250	1/2,500	1/5,000	1/12,500	1/25,000	Dilution showing standard
V. cholera—											
Calcutta I ..	T	T	T	T	T	T	S +	S	Tr	..	1/5,000
Armstrong ..	—	—	—	—	—	—	—	—	—	—	Nil
Johnson ..	—	—	—	—	—	—	—	—	—	—	Nil
Constantinople II	T	T	T —	S	Tr +	Tr	—	—	—	—	1/250
Ladu Tadu ..	—	—	—	—	—	—	—	—	—	—	Nil
2,870	T	T	T —	S +	S	Tr	Tr	—	—	—	1/500
1,554	T	T	T —	S +	S	Tr	Tr	—	—	—	1/500
Jalgaon ..	T	T	T —	T —	T —	S +	S	—	—	—	1/2,500
1,624	T	T	T —	T —	T —	S +	S	Tr	..	..	1/2,500
Krisna	—	—	—	—	—	—	—	—	—	—	Nil
627	T	T	T	T —	T —	S +	S	Tr	—	—	1/2,500
120	T	T	T	T —	T —	T —	S	Tr	—	—	1/2,500
Calcutta II ..	T	T	T	T —	S +	S	S —	—	—	—	1/1,250
King's Institute I	T	T	T	T —	S +	S	Tr	—	—	—	1/1,250
King's Institute V	T	T	T	T —	S +	S	Tr	—	—	—	1/1,250
Constantinople III	T	T	T	T —	S +	S	Tr	—	—	—	1/1,250
Jenkins ..	T	T	T	T —	T —	S +	S	Tr	—	—	1/2,500
1,256	—	—	—	—	—	—	—	—	—	—	Nil
Bevan	—	—	—	—	—	—	—	—	—	—	Nil
Mysore ..	T	T	T	T —	T —	T —	S +	S	Tr	—	1/5,000

Agglutinating serum was now prepared for the strain Armstrong. Considerable difficulty was experienced in obtaining an efficient agglutinating serum, and several injections of living cultures had to be given before a serum of even low titre could be obtained. One of the rabbits died in the course of immunization. It had received four injections of living cultures and several of dead. None of the changes noted by Greig [6] in the gall-bladder were found. Cultures from the blood, gall-bladder and large intestine showed no vibrios, the two former being sterile.

Table II.—Gives the result of tests with *V. cholera* Armstrong serum. It will be seen that this serum agglutinated all the strains, four of them, however, came down in dilutions of one-tenth or less of the full titre.

Absorption Tests.

Technique.—Cultures were grown on agar slopes for twenty-four hours. The growth of three slopes of each strain was emulsified in two cubic centimetres of normal saline. A 1 in 10 dilution of the serum to be absorbed

was made in this emulsion by the dropping method. Controls of 1 in 10 dilution of the serum in normal saline were put up at the same time. The tubes were placed in a 37° C. incubator for two hours and then put in the cold room overnight. The next day the tubes were centrifuged and the absorbed serum and controls tested.

With a view to determining the relationship of the two strains, Calcutta I and Armstrong, Armstrong serum was absorbed by these two organisms.

TABLE II.—SERUM FOR *V. cholera* ARMSTRONG.

	Dilutions of Serum										
	25	50	1/125	1/250	1/500	1/1,250	1/2,500	1/5,000	1/12,500	1/25,000	Dilution showing standard
V. cholera—											
Armstrong ..	T	T	T –	S +	S +	S +	S +	S –	—	—	1/3,500
Bevan ..	T	T	T –	S +	S +	S	Tr	—	—	—	1/1,250
Krishna ..	T	T	T –	T –	S +	S +	S	Tr	—	—	1/2,500
1256 ..	T	T	T –	S +	S +	S +	S	Tr	—	—	1/2,500
Johnson ..	T	T	T –	T –	S +	S +	S	Tr	—	—	1/2,500
2870 ..	T	T	T	T –	S +	S +	S +	S	—	—	1/2,500
1624 ..	T	T	T	T –	S +	S +	S +	S	—	—	1/2,500
627	T	T	T	T –	T –	Tr	—	—	—	—	1/745
Jenkins ..	T	T	T	S +	S	Tr	—	—	—	—	1/500
King's Institute I	T	T	T	T –	S +	S +	S +	S	—	—	1/5,000
King's Institute V	T	T	T	T –	S +	S +	S +	S	—	—	1/5,000
Constantinople III	T	T	T	T –	S +	S +	S	Tr	—	—	1/2,500
Jalgaon ..	T	T –	S +	S +	S	Tr	—	—	—	—	1/500
Calcutta II ..	T	T –	S +	S +	S +	Tr	—	—	—	—	1/700
1554 ..	T	T –	T –	T –	S +	S +	S +	S –	—	—	1/3,500
Constantinople II	T	T	T –	T –	S +	S +	S +	S –	—	—	1/3,500
Laru Tadu ..	S +	S +	S +	S	S –	Tr	—	—	—	—	1/250
120	S +	S +	S	Tr	—	—	—	—	—	—	1/125
Mysore ..	S	S	Tr	Tr	—	—	—	—	—	—	1/50
Calcutta I ..	S	Tr	——	—	—	—	—	—	—	—	1/25

T = Total agglutination.
T – = Less than total, but more than standard.
S = Standard agglutination, Dreyer's.
Tr = Trace of agglutination.

As will be seen in Table III, strain Calcutta I does not remove the agglutinins for strain Armstrong except only to a negligible extent. Strain Armstrong, however, removes the agglutinins for itself and for *V. cholera* Calcutta I. The two strains are, therefore, not homologous but appear to belong to different serological types.

It now remained to examine the absorption power of the other strains under investigation on both Calcutta I serum and Armstrong serum. Absorption tests were made with Calcutta I serum in the first place; each of the strains, including Laru Tadu, which agglutinated with this serum,

was found to be homologous and capable of exhausting the serum of all agglutinins in dilutions of one in fifty upwards.

The results of absorption tests with Armstrong serum are shown in Table III. Only seven out of the twenty strains are shown on this table. Six of these proved to be heterologous and incapable of exhausting the agglutinins for Armstrong from the serum. The remaining thirteen strains were all tested by the absorption method with Armstrong's serum, and all proved to be homologous with strain Armstrong.

Discussion.

The twenty strains appear to fall into three groups as follows:—

Group I.—There are six vibrios in the Calcutta I group. They all agglutinate with Calcutta I serum, and when the absorption test is applied remove all the agglutinins from this serum. All of them agglutinate to

Table III.

Serum	End point of agglutination titre for:						
	V. Armstrong	V. 1554	V. Constantinople II	V. Laru Tadu	V. 120	V. Mysore	V. Calcutta I
V. Armstrong (unabsorbed) ..	3,500	3,500	3,500	1,250	125	50	25
Absorbed with:							
V. Armstrong	< 25	< 25	< 25	< 25	< 25	< 25	< 25
V. 1554	800	< 25	..	..	..	..	..
V. Constantinople I ..	800	..	< 25	..	..	..	..
V. Laru Tadu	1,250	..	..	< 25	..	..	..
V. 120	1,250	..	..	..	< 25	..	..
V. Mysore	500	..	..	..	..	< 25	..
V. Calcutta I	2,500	..	..	..	..	..	< 25

some extent and two to full titre with *V. cholera* Armstrong serum, but fail to remove the homologous agglutinins from this serum.—*Vide* Table III.

Group II.—There are five organisms in the Armstrong group. None of these agglutinate with *V. cholera* Calcutta I serum. Although Armstrong serum agglutinates all the organisms of Group I yet none of these are found capable of absorbing the Armstrong agglutinins from Armstrong serum.

Group III.—In this group are nine organisms which agglutinate with both Group I and Group II sera. These organisms in absorption tests remove all agglutinins from both type sera.

Two possible explanations of these results are suggested. Firstly, Arkwright [7] has shown that cultures of certain organisms can split off two varieties of colony which he has called rough and smooth. The normal culture appears to be a mixture of the two. These varieties differ from one another in their agglutinating, antigenic and absorbing properties. It may

be assumed, in this case, that Calcutta I serum was prepared with the rough variety and Armstrong serum with a smooth variety.

The cultures of pure rough and smooth variety would agglutinate with, and absorb agglutinins from, the corresponding serum only. These cultures would fall into either Group I or Group II. Cultures like those of Group III which agglutinate with, and absorb agglutinins from, both sera must be assumed to be mixtures of both varieties. Secondly, the cholera antigen may be imagined to be constructed of two parts, each of different antigenic composition. Organisms like *V. cholera* Calcutta I and *V. cholera* Armstrong consist chiefly of one part which gives the distinctive serological reactions of that part. The organisms of Group III have the two components in more or less equal proportion.

Conclusions.

All the vibrios examined agree in the following particulars :

(1) They are non-hæmolytic.

(2) They have one terminal flagellum.

(3) They have similar biochemical reactions as far as these were examined. They all liquefied gelatin and gave the cholera red reaction.

Serological Reactions.—There appear to be two serological groups. These types may or may not be distinguishable by the agglutination tests only, according to the serum used. They can be distinctly defined by absorption tests.

This work emphasizes the importance of using a suitable antigen for preparing agglutinating serum. If only one serum be used for diagnostic purposes it must have the property of agglutinating all strains.

References.

[1] Mackie, T. J. *Brit. Journ. Exper. Path.*, iii, 1922.
[2] Craster. *Journ. Exper. Med.*, xix, 1914.
[3] Greig, E. D. W. *Ind. Journ. Med. Res.*, iii, 1916.
[4] Douglas, T. R. *Brit. Journ. Exper. Path.*, ii, 1921.
[5] Greig, E. D. W. *Ind. Journ. Med. Res.*, ii, 1914.
[6] *Idem. Ibid.*, iii, 1915.
[7] Arkwright, J. A. *Journ. of Path. and Bact.*, xxiv, 1921.

Clinical and other Notes.

UNUSUAL CASE OF FRACTURE OF TIBIA INVOLVING KNEE-JOINT.

By Captain W. B. SWETE-EVANS.
Royal Army Medical Corps.

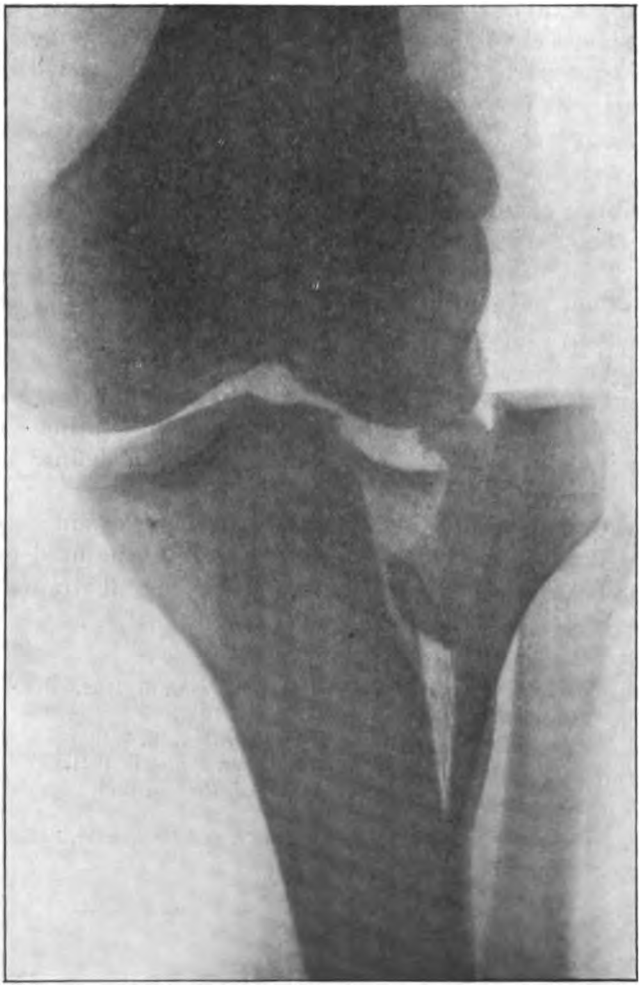


Fig. (*a*).

Pte. J. B., aged 24, was admitted to the Military Hospital, Belfast, on June 10, 1924, with his left knee swollen to the size of a Rugby football, and so tense that no bony points could be identified, save the patella, which seemed partly dislocated outwards. There was a large abrasion above and

outside the knee in the lower third of the thigh. He gave a curious history. He was playing in a "Soccer" match, and was almost in the goalmouth when he slipped and fell with his leg bent. The goalkeeper jumped in the air to punch away the ball and came down on the outer side of Pte. B.——'s thigh, just above the knee. An X-ray was taken imme-

Fig. (*b*).

diately after admission (Fig. (*a*)). This showed a vertical fracture, or rather fissure, of the tibia, extending from the knee-joint, on the outer side of the crucial ligaments, about three to four inches down the shaft of the tibia, with pieces of bone wedged in the fissure.

The leg was placed between sandbags on a pillow. On June 16, 1924 (six days after the accident) on the advice, and with the help of Colonel A.

Fullerton, Consulting Surgeon to the Northern Ireland District, the knee was opened with a long vertical incision on the outer side of the tibia over the fissure. A great deal of blood and mashed bone was expressed, and a piece of bone was found about 1½ in. square, with part of the semi-lunar cartilage attached, wedged firmly in the fissure.

This was evidently part of the articulating surface of the tibia.

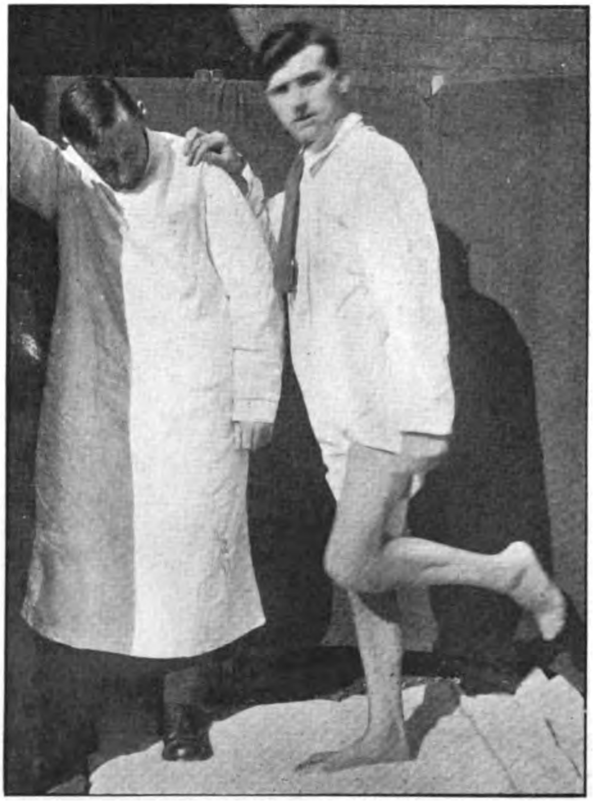


FIG. (c).

With great difficulty this piece of bone was levered out, and two 2½-in. screws were inserted from without inwards in an attempt to close the fissure. After much trouble, owing to the screws failing to bite in the cancellous tissue, the fissure was almost closed and the wound was sewn up. An X-ray photograph was taken at once (Fig. (*b*)) and the patient put back to bed on a McIntyre's splint. He suffered from some degree of shock and was given pituitrin (one cubic centimetre) every four hours. His temperature next morning was 100·2, pulse 100, and he had a troublesome cough. The pyrexia lasted for three days, but fell to normal on the 20th. The knee gave little or no pain.

The stitches were removed on the tenth day (wound healed by primary union), and on the same day the splint was taken off and passive movement started with gentle massage. He got up in a chair just four weeks after the operation. The knee-joint could only be flexed through about an angle of thirty degrees, and on July 24, 1924, and again on August 9, 1924, the joint was forcibly moved under general anæsthesia and a great many adhesions broken down. Massage and passive movements were continued twice a day.

Since then progress in movement has been most satisfactory, and he can now walk well up and down stairs, without a stick, and bend the knee to an angle of forty degrees (fig. (*C*)). The accident is a most unusual one, and apparently the outer condyle of the femur was driven by the blow of the goalkeeper's boots so violently against the upper surface of the tibia that it not only fractured that surface, but drove the fragments into the tibia, whilst splitting it vertically.

The patient has now gone on leave for two months, with every prospect of being able to continue his military services on his return.

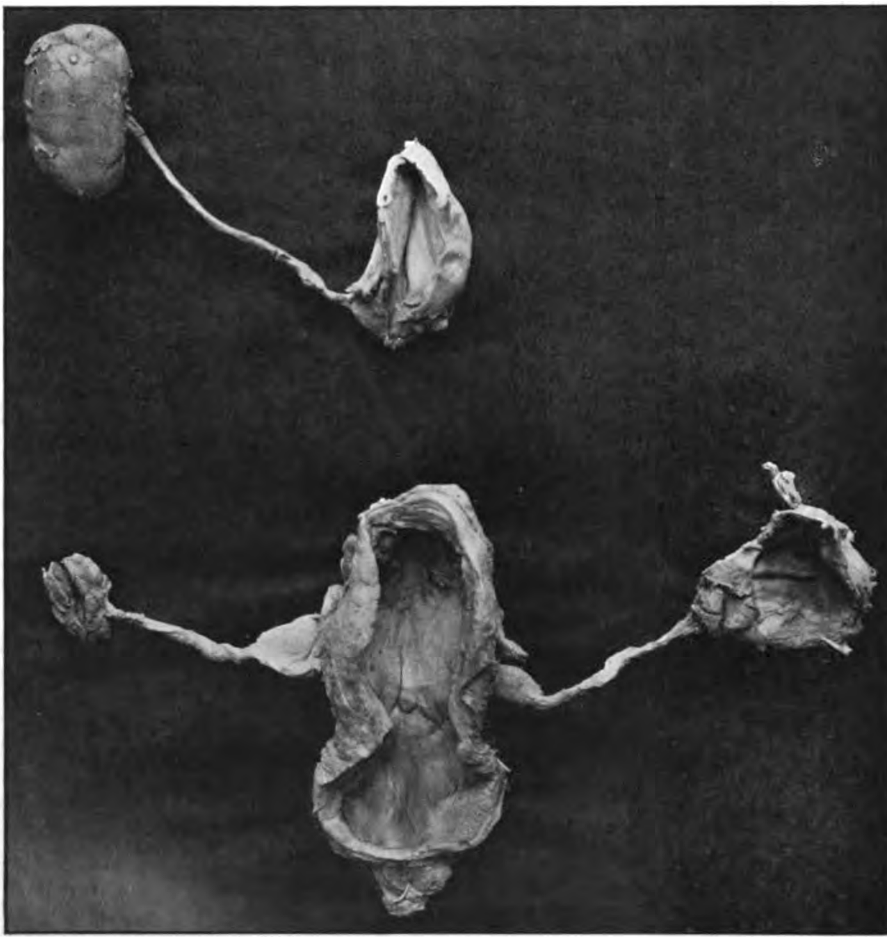
NOTES ON A CASE OF CONGENITAL ABNORMALITIES OF THE BLADDER AND KIDNEYS.

By Captain R. W. SWAYNE, O.B.E.
Royal Army Medical Corps.

A healthy primipara, aged 20, was delivered normally in July, 1924, of twin boys. One of the infants was healthy and continues to thrive, the other only lived a few minutes and is the subject of this report. *Post-mortem examination*: Male child, lived a few minutes after birth. Maturity about forty weeks. Weight 5 lb. 11 oz., well nourished generally except for the abdominal wall which is poorly developed and is flabby, but is quite intact. A condition of club hand is present in the left upper extremity, the hand being acutely flexed but both the radius and ulna are present. Both feet are in the position of talipes equino-varus. The lungs show very little signs of inflation and for the most part sink in water. There are about two ounces of reddish coloured fluid in the right pleural space. The heart is normal. On opening the abdomen a few ounces of free fluid were found. The liver, spleen, stomach and intestines appear to be normal. The left kidney is very small, measuring $\frac{7}{8}$ inch in the long axis, there is a cyst of the left ureter at its entrance to the bladder. The actual kidney substance on the right side is less than that of left but there is a cyst measuring $1\frac{1}{2}$ inches in diameter attached to its outer side. There is also a small cyst of the right ureter in the corresponding position to that on the other side. The bladder is enlarged and presents marked hypertrophy. At its thickest part the bladder wall measures $\frac{1}{4}$ inch. About the middle

there is a constriction which divides the organ into two parts. Just above this constriction the ureters are attached. The bladder exit is very minute. The contents of the cysts give slight effervescence when treated with sodii hypobrom. At the fundus of the bladder there is a gritty material suggesting phosphatic deposit.

On further examination of the specimen I have come to the conclusion



that the part below the constriction is not bladder at all but is a greatly enlarged prostatic urethra, the walls of which are as thick as those of the bladder itself. The constricting part must therefore be regarded as the sphincter, allowing an opening between the bladder and urethra of $\frac{3}{4}$ inch in diameter. In removing the specimen the prostate gland was not seen, but this is not to be wondered at, as at this age it is extremely small. "Thomson states that at the age of 7 years the prostate gland only weighs

thirty grains, whereas in subjects between 18 and 20 years it weighs 250 grains" (Treves) [1].

The accompanying photograph gives a good idea of the condition found. The upper specimen is the bladder and one kidney of a female child of the same age and maturity. Both specimens have been photographed on the same plate for comparative purposes, and the bladder has been opened from the back in each case. The constriction and hypertrophied walls of the abnormal bladder can be very well seen. In the prostatic portion a median groove can be made out where the wall is thin and transmits light. The lowest portion, pierced by a pin in the photograph, appears to be the membranous urethra and a part of the bulb. In this portion the urethra was extremely minute and could not be dissected out. Unfortunately, the remainder of the penile urethra was not examined. In both specimens the hypogastric arteries can be seen immediately above the ureters. The regarding of the dilated portion below the constriction as being the prostatic urethra, explains the ureteric attachments, which were at first rather puzzling.

I do not profess to be able to explain the above described deviations from the normal, but would like to make a few suggestions. "The bladder wall in the child is so thin that in sounding for stone it is said that a click can be elicited by striking the pelvis through the parieties of the viscus" (Treves) [2]. I have just described an infant's bladder that some medical friends at a first glance took to be the adult uterus. To account for the great increase of the musculature, I think that one is justified in assuming that the organ was endeavouring to discharge its contents against a greatly increased resistance. We know that all hollow muscular organs hypertrophy under such condition in order to overcome, if possible, the obstruction which interferes with their emptying. A typical example of this is supplied by the adult bladder when associated with prostatic enlargement, leading to obstruction. But that the bladder does empty itself during intrauterine life, although very probable, is not as far as I know an established fact. Johnstone, in "A Text-book of Midwifery," published last year, in discussing the liquor amnii, states: "The origin of the liquor amnii is not known with certainty. It is probably derived from the amnion itself, by transudation from the maternal vessels of the uterine wall. It is probable that in the later months it is derived from the fœtal kidneys" [3]. The same author states: "It is possible that some urea may be excreted into the liquor amnii by antenatal micturition." The works of other writers that I have consulted are not more dogmatic on this subject.

It would seem, that in the case under review the bladder was operating under an increased resistance to its emptying itself into the amniotic sac. The cystic condition of the ureters points to this same back pressure.

I must confess that I find it harder to account for the atrophic condition of the kidneys. Atrophy follows a complete block, whereas the vesical hypertrophy points in this case to a more gradual process and this

in its turn one would expect to have led to hydronephrosis. After careful examination I cannot satisfy myself that this is the pathological explanation of the cystic condition of the right kidney. There is no dilatation of the renal end of the ureter present and it ends in compact tissue, and this tissue is interposed between the ureter and the cyst.

Can it be that these kidneys were at one time normal, that the back pressure was borne principally by the bladder and vesical ends of the ureters, and that later a complete block led to renal atrophy and cystic degeneration? Was the free fluid which was present in the serous spaces due to the final renal inefficiency? These questions I fear I can only ask but cannot answer.

I am indebted to Lieutenant-Colonel J. H. R. Bond, C.B.E., D.S.O., R.A.M.C., Commanding Officer, 36 Casualty Clearing Station, B.A.O.R., and to Major E. L. Moss, C.M.G., M.C., R.A.M.C., Officer Commanding Military Families Hospital, B.A.O.R., for permission to publish these notes. The excellent photograph was taken by Corporal J. W. Stewart, R.A.M.C., of the X-Ray Department, 36 Casualty Clearing Station, B.A.O.R.

REFERENCES.

[1] Treves and Keith. "Surgical Applied Anatomy," 7th edition, p. 491.
[2] *Idem. Ibid.*, p. 491.
[3] Johnstone. "A Text-book of Midwifery," 4th edition, p. 62.

A SMALL OUTBREAK OF "MUSHROOM" POISONING DUE TO *INOCYBE INCARNATA*.

By Captain (Temp. Major) T. YOUNG.
Royal Army Medical Corps.

First Group of Cases.

On the evening of June 25, 1924, a corporal and six fusiliers of the 1st Battalion, the Lancashire Fusiliers, Tidworth, were admitted to hospital complaining of giddiness, blindness and cold clammy sweats. They were in a state of collapse, pale, sweating profusely, temperature subnormal, pulse slow and feeble, pupils widely dilated except in one case, where they were normal. Two men only vomited. No pain was complained of. Treatment consisted of gastric lavage, injection of atropin 1/50 gr., application of hot-water bottles and administration of castor oil and brandy. Recovery was rapid; next morning temperature and pulse were normal, patients felt quite well and all were discharged to duty on June 27.

It was found that four or five hours previous to the onset of symptoms, a party of the Lancashire Fusiliers had picked and eaten some "mushrooms" which they had found growing on the Plain within a mile or so of the barracks. Two other men reported sick complaining of sweats and

with dilated pupils. They were not detained. It was ascertained later that several others were out of sorts for a short period, and also that some who had consumed the fungi were apparently not affected.

The fungi concerned proved to be *Inocybe incarnata*, as stated below.

Second Group of Cases.

On June 27, 1924, four gunners at Larkhill partook of "mushrooms" at breakfast time. They had collected these the previous day and shown them to the Sergeant Cook, who pronounced them genuine, and cooked them. The four men were proceeding on pass to Bournemouth, but one was taken ill shortly after breakfast and sent to hospital in a state of collapse. His symptoms were the same as in the previous cases but to a greater degree, and he was very ill for two or three days. On admission his temperature was 97° F., pulse 40, and pupils dilated. His face was flushed, he was shivering and perspiring very freely. Slight vomiting took place, and he passed a small greenish stool. He was very thirsty and complained of some pain in the right hypochondriac region. Atropin 1/50 gr. was administered and the stomach washed out, the contents being greenish in colour. He slept badly, and next morning his pulse was 90 and temperature 99·4° F. He still complained of pain in the right side, and at times all over the abdomen. He had no more vomiting and was exceedingly thirsty. Castor oil was administered. On the 29th he passed fragments of "mushrooms." On the 30th his condition was much improved, and he was discharged from hospital July 5, 1924.

The other three men started out for Bournemouth but took ill on the way and were admitted to a civil hospital in Salisbury. Symptoms were similar but mild and they were discharged the following day. Treatment was similar to that administered in the Military Hospital.

The offending fungus in these cases was also *I. incarnata*. Orders were immediately published drawing the attention of all ranks to the danger of eating fungi liable to be mistaken for "mushrooms," and no further cases occurred.

Differentiation of Edible and Non-Edible Fungi.

In the course of a correspondence concerning these cases, the following notes with explanatory sketches were provided by Lieut.-Colonel W. P. MacArthur, Royal Army Medical College. They are reproduced here, as others may find them useful:—

There is no general test that can be applied to differentiate edible and poisonous fungi. The only means of knowing whether a given fungus is poisonous or not is to have the species identified and ascertain its record in this respect. Under military conditions such an exact procedure would usually prove impracticable, and in the absence of expert knowledge we must be content to identify the common edible species, and discard all other mushrooms whether poisonous or not.

The common edible mushroom found in pastures, *Psalliota campestris*, shows in conjunction three easily recognizable characters:—

(1) The cap [fig. 1] is white to buff in colour.

(2) Except in the tiny "button" stage, in which they may be white, the gills [fig. 1] are salmon pink in colour, becoming with growth purplish brown.

(3) The stem has a "ring," i.e., in the young stage there is a membrane joining the edge of the cap to the stem [fig. 2], and as growth proceeds this ruptures and hangs from the stem as a ring [fig. 1].

Further, any mushroom with a sheath-like formation on its stem is probably dangerous [fig. 3].

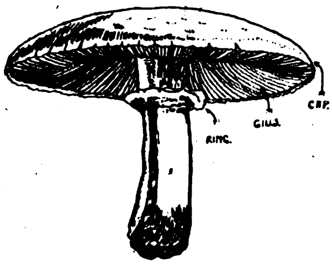


FIG. 1.

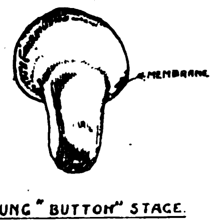


FIG. 2.

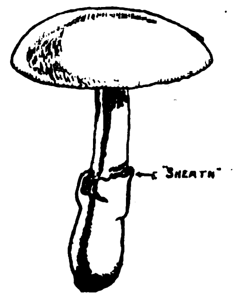


FIG. 3.

The above simple tests will eliminate all the poisonous species, but one must not assume that every mushroom lacking these three characters in conjunction is necessarily dangerous, though it may be so. All stages of of *P. campestris* will pass the test, as will many of the equally edible *P. arvensis*; some stages of the latter, especially if grown on very rich soil, would be rejected because of the colour of the cap. It is better to waste such rather than complicate matters by introducing too wide a range of admissible colours.

The popular beliefs that poisonous mushrooms in cooking will discolour a silver spoon, and that only edible mushrooms have alternately long and short striæ on the gills are erroneous.

I. incarnata is the species responsible for both the outbreaks of poisoning which you report, this identification being kindly made by Mr. Ramsbottom, of the British Museum (Natural History). These fungi would have been rejected immediately by the above tests, for they show pinkish caps, clay coloured gills, and no ring on the stem.

Travel.

A VISIT TO HAVANA, CUBA.

By Major W. F. M. LOUGHNAN, M.C.
Royal Army Medical Corps.

Cuba is the largest of the West Indian Islands which constitute the Columbian Archipelago. It lies between 74° 11′ and 84° 58′ west longitude, and between 19° 47′ and 23° 9′ west latitude. The greatest length of the island is about 800 miles, the width varies from about 30 to 130 miles, so that it has an elongate shape. Habana the capital of Cuba is situated within about six hours' steam from Florida, and less than 100 miles from Key West.

The original inhabitants of Cuba were the Cibuny Indians, an offshoot of the widespread Arrawak race, and are said to be descended from the Creek Tribe which came from Florida. They occupied the whole of the island except a small portion on the western shore which was held by the Guanahacabibes, who came of a Carib stock. All the aborigines were annihilated before the year 1600 by the early European planters.

Cuba was discovered by Columbus in 1492, and he is reputed to have said "Esta es la tierra mas hermosa que vieron ojos humanos" (This is the most beautiful land that human eyes have ever seen).

Sebastian de Ocampto circumnavigated and explored the whole coast line in 1508, and on this voyage the harbour of Havana was discovered and it was here that Ocampto beached and repaired his ships.

The island was first named Iuana after Prince John, son of Ferdinand and Isabella, but on the death of King Ferdinand it was changed to Fernandina in honour of the Castilian sovereign in whose reign the island was discovered. Later it was again changed to Santiago after the patron saint of Spain, and at a still later period re-named Ave Maria after the Virgin Mary. The present name Cuba is Arrawak in origin, and which literally translated means a "jar of oil." In 1511, Diego Columbus, son of the great admiral, sent an expedition under the command of Velasquez for the colonization of Cuba. This fleet set sail from San Domingo and landed on the northern coast somewhere near the town of Guantanamo. Very little progress was made in colonizing at this part, and the expedition appears to have been withdrawn owing to unfavourable conditions.

In 1512 Baracoa was founded on the northern coast. After establishing colonies at Bayamo and Trinidad on the southern coast Velasquez founded Santiago in 1514. In 1515 Velasquez settled a colony at Batabano near the mouth of the Guines River on the southern coast of the island. This settlement was originally known as San Cristobal de Habana. From this colony the present Habana was founded in 1519.

The landing place of the first settlers in Havana is marked by a small church known as "El Templet," and close by is a cotton tree, which is said to be an offshoot of the original ciba tree, under which mass was first celebrated on the landing of the first colonists. The early history of Cuba is comprised in the many vicissitudes she underwent at the hands of the pirates and buccaneers.

Havana was completely destroyed by French pirates in 1538 and again in 1554. Drake attempted to take the city in 1585 and 1592.

Several efforts were made to fortify the city, but the fortifications were not complete until 1665. The defences consisted of two forts on the west side of the entrance to the harbour, namely "Bateria de la Punta" or Point Battery and "La Fuerza" or Fort, both of which are still to be seen grimy and hoary with age, and practically unaltered by time. At the eastern side of the entrance to the harbour, Morro Castle completed the earliest defences of the city. In addition to these redoubts the city was strongly walled in accordance with the Spanish architectural design of the sixteenth century. From the date of the completion of these defences, Havana became an impregnable city, and its harbour was a safe rendezvous for Spain's richly laden galleons.

It was from Havana that de Narvarez's ill-fated adventure sailed for Florida in 1528; from here also sailed de Soto's great expedition in 1539, for the conquest of Florida.

In 1752 Havana was captured by Lord Albemarle with a fleet of 200 ships and 15,000 men. It remained under British rule for one year until exchanged for Florida.

In 1899 Cuba became an American possession. In 1902 a republic was established under Toma Estrada Palma as first president.

The former rulers of Cuba gave her the title of Pearl of the Antilles. Her stately mountains and verdant valleys are unrivalled. The tropical foliage and vegetation are unique, while the forests contain lignum. mahogany, cedar, logwood and many species of palms, the well known royal palm (*Orodoxa regia*) which is distributed throughout the island is of great commercial value; it is put to many local uses. The roots have medicinal properties, the wood is made into beams and boards, the buds of the central spines are eaten, while the fibrous leaves are made into water buckets, and domestic utensils.

The "Vegas" or tobacco plantations are best seen on the southern plains and valleys. The tobacco is sown in small plots, part of which is planted with banana trees, which provide a useful shade for the tobacco plant. The upper leaves of the plant are best, and when matured they are dark brown in colour, unspotted, and yield the most delicious smoke, burning evenly with a grey ash which adheres to the cigar, until it is almost completely consumed.

The tobacco plant under favourable circumstances may be planted, grown and be fit for gathering in the short space of three months. The

cigar itself was first made and smoked by the Cuban aborigines, and was called by them tobaccos; this term was later extended to the tobacco plant itself, the true name of which is cohiba.

In the city of Havana there are 86 cigar factories; among these are the Henry Clay and Bock factory, Calixto Lopez, Roderiquez Arquelles Co., "Romeo and Juliet," Pantajas, &c., &c. A visit to one of the large factories is well worth making.

On the open central plains, sugar-cane cultivation predominates. The sugar industry is the most important in the world. Cuba boasts of the best canes, the most suitable soil for sugar production, and the most up-to-date sugar crushing machinery.

The cafetelas or "coffee plantations" in former times were a flourishing industry in the island, but in recent years they have been almost super seded by sugar cultivation. The island possesses only two indigenous mammals, the insect-eating solenodon and the large tree rat.

Deer have been imported, and in many districts deer hunting is a great sport.

Birds are to be found, many of which are beautifully coloured, while some are good songsters. Wildfowl are plentiful and afford good sport on the swamps. Snakes and other reptiles are common throughout the island, but they are all non-venomous.

Alligators live in the swamps and estuaries. The insects are common to many of the West Indian islands and consist of centipedes, cockroaches, fleas, fireflies, mosquitoes, tarantulas, ticks and jiggers.

On entering Havana harbour, one is first struck by the historic Morro Castle standing boldly on a rocky promontory on the eastern side, while on the opposite side the city is seen extending for miles along the water's edge. The harbour itself indicates the commercial prosperity of the city. Along the wharves are to be seen vessels of all nations loading and discharging their cargoes, while tugs, ferry boats, barges, launches and row boats are continually moving in all directions.

On looking at the city from the sea, one notices huge modern commercial buildings intermingled with ancient monastic towers and belfries.

Havana has a population of 400,000. It is a clean, healthy, well regulated city. The water supply and sanitary arrangements are most excellent. The temperature at Havana in summer varies from 76° F. to 82° F. and in winter it ranges between 50° F. and 78° F. In the cold season the climate is delightful, and it is an ideal tourist resort. On landing at Havana the visitor is first attracted by the extraordinary narrow streets, and through these very limited thoroughfares there is a constant stream of every imaginable kind of traffic, including tram-cars, huge motor trucks, automobiles and country carts. The traffic is extraordinarily well regulated, the drivers are skilful and accidents are unusual.

Several of the streets have picturesque awnings stretched across them in canopy fashion, which yield a pleasant shade to the pedestrian. For

comfort when seeing Havana the visitor is recommended to hire a coche (this is a four-wheeled landau-like equipage) and drive to any particular place of interest he wishes to see. These coches are extraordinarily cheap and may be hired at any corner or street, when one or two persons may travel from any one point to another within the city for the sum of 20 cents. Tram-cars are also available but they are slow and not very comfortable.

Havana is said to have more taxi cabs for its size than any other city in the world. Alcohol made from molasses is largely used as fuel for automobiles. The Prado, one of Havana's most beautiful boulevards, was built by General Tacon during the Spanish régime. It was greatly improved and extended during the American occupation. It extends from

Prado Promenade.

Colon Park to the Malecon, a distance of two miles. At the entrance to Colon Park is the statue of La Habana or La India, an Indian goddess. From here the visitor may drive down the Prado to the Malecon by the sea front amidst the choicest flowering shrubs blended with brilliant paunciauas, and the pleasant shading of wavy palms. The boulevard is asphalted and planned with great taste. On either side of the drive are situated some of the finest residences, hotels and club houses in Havana. During the afternoon the Prado is a fashionable drive thronged with luxurious and costly automobiles of all sizes. At night it is a brilliant spectacle, full of life and gaiety, when its light-hearted habitués know how to enjoy themselves thoroughly. The Prado ends at the Malecon in a large open space in the centre of which is situated the bandstand.

The old Punta battery is located here, it is one of the oldest fortifications in Havana. Its odd sentry boxes, old guns and deep moat are worth seeing. Colon cemetery deserves a visit, it contains many fine monuments and is well kept. The Botanical Gardens are picturesquely laid out, there is a very good selection of palms which are of great botanical interest. The Velado is a modern residential suburb and is connected with the city by tram lines. It contains many modern residences with delighful gardens covered with the most exquisite flowering shrubs and creepers.

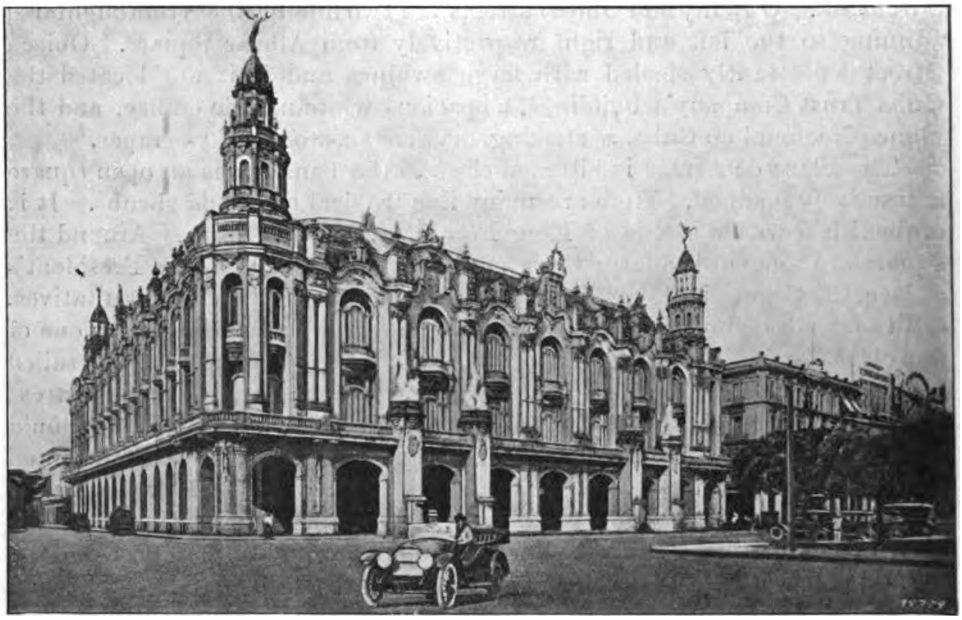
Havana has several excellent markets, all of which are well regulated, and supervised in accordance with the most modern tropical hygienic requirements. The largest are the Tacon and Colon markets which the visitor should see; here almost any Western tropical esculent can be purchased. O'Reilly and Obisco streets are two fine business thoroughfares running to the left and right respectively from Albear Square. Obisco Street is pleasantly shaded with large awnings and in it are located the Cuba Trust Company's buildings, a spacious white marble edifice, and the Banco Nacional de Cuba, a striking massive six-storied sky-scraper.

The Plaza de Armas is situated close to the bank; it is an open square attractively planned. Here are many fine tropical trees and shrubs. It is embellished with a statue of King Ferdinand VII. of Spain. Around the square are some of the large Government buildings, such as the President's palace, the Senate building, the Post Office and the Hall of Representatives. On the north end of the square is the historic La Fuerza Fort, it is one of the oldest fortifications in Cuba and was built by de Soto in 1538, who sailed for the conquest of Florida in the following year. It was in this fortress that Doña Isabel de Bobadilla, his wife, was left by him until he should return from his great adventure. Unfortunately de Soto's death prevented him from returning and Doña Isabel is said to have died of a broken heart, having waited for four long years for the return of Don Ferdinand. This quaint old fort has witnessed many sanguinary fights and survived the assaults of pirates and buccaneers. It was destroyed by de Sores, a French pirate, in 1544. In 1762 it was taken by the British troops under Lord Albemarle, who after capturing Morro Castle on the opposite side of the harbour trained the guns of the latter fortress on it, which caused the capitulation of Havana.

When in O'Reilly Street one should visit San Domingo Cathedral; the foundation of this church was laid in 1656, but it was not completed until 1724. It is an example of Gothic architecture and has a time worn appearance. It contains several beautiful paintings by old masters, one of which is a supposed Murillo. The altar is an impressive structure built of the finest Italian marble and surrounded by a mosaic floor. The Cathedral is famous in having been the resting place of the bones of Columbus. He was first buried at Valladolid, Spain, in 1508, and re-interred at Seville. The remains were taken later to the island of San Domingo and entombed in the cathedral in San Domingo city. When San Domingo was taken by

the French in 1795, the Spaniards, on evacuating the island, removed the bones of the great navigator and took them to Havana, where they were interred in a beautiful tomb beneath the dome, and here they remained in San Domingo church, Havana, until the evacuation of Cuba by the Spaniards, when the remains were again transferred to the Cathedral of Seville, Spain.

The clubs and amusements are numerous and most up-to-date. The American Club, situated at the corner of Vitudes Street and the Prado, is a large modern building and is well known. The Austurias and Gallegas Clubs are also located in the city, and have an enormous membership. At Oriental Park, Mariano, not far from the city, is a beautiful racecourse,



Gallego's Club and National Theatre.

the grounds are exquisitely laid out with the most gorgeous flowers, ornamental shrubs and royal palms. There is an imposing club house which is a three-storied building luxuriously equipped in every respect. A verandah fronts the first floor on the racecourse side, from which the races can be seen, and on the roof garden is a large café and ballroom.

There are two large stands capable of holding 12,000 people. The race meetings are very popular and attract large crowds. The grounds and buildings are owned by the Cuba-American Jockey and Auto Club. The entrance fee to this club is 500 dollars, and there is an annual subscription of 100 dollars.

The Havana Casino was built in 1918 and fitted with perfectly appointed playing rooms, banqueting halls and dancing floors. The

cuisine of this club is world famed. At night the Casino is thronged with people from the city and the neighbouring suburbs, and offers all the attractions common to fashionable institutions of this sort.

At Marianao beach not far from the suburban town of that name is located the Havana Yacht Club. It is much patronized by holiday makers and bathers in fashionable and attractive costumes.

The Country Club, with its sporting golf links, tennis courts, croquet lawns and extensive grounds, is also situated near Marianao. There are two baseball grounds, the Almendares and the Tacon. The former is the larger and the best games can be seen there.

Marti Statue, Inglaterra and Telegrafo Hotels.

There are several theatres in Havana, of which the National Theatre is the most notable; it is one of the largest theatres in the world, it has seating accommodation for 3,000 people and some of the best actors and operatic singers have performed there at one time or another during the season.

The Havana lottery deserves mention. It is a well-run game of chance. Tickets can be purchased at 25 cents each almost anywhere throughout the city.

Havana has a wonderful selection of first-class hotels, namely, the Almendares, Belvidere, Brooklyn, Florida, Grand American, Harding, Harigan, Ingleterra, Isle de Cuba, Lafayette, Maison Royal, Mac Alpine, New York, Pasaje, Royal Palms, Saratoga, Trianon, Telegrafo, Trojda and Vanderbilt.

Life in the old part of the Havana city is very interesting. It is the

custom of the Cubans to rise early and take a light breakfast. About 11 o'clock lunch is partaken of, after which a long rest is indulged in. From about 4 o'clock until nightfall are the busiest hours. After dinner, which is about 7 o'clock, until about the small hours of the morning, theatres, cinemas, cafes, restaurants are patronized. Some of the parks and the Prado are full of people until 2 or 3 o'clock in the morning.

Abstract.

Command and Conduct of Operations for Forces consisting of all Arms. Translated from the German Regulations. General Staff, War Office, July, 1924.—These Regulations are issued by the Chief of the Staff, Berlin, and in the introductory letter it is stated that they are based on the strength, armament and equipment of the army of a modern great military power, and not only on the German army of 100,000 men formed in accordance with the Peace Treaty.

There are eighteen sections; the Regulations for the Army Medical Service are dealt with in Section XVII G.

General Organization.

The medical service is responsible for sanitary services, the professional treatment and care of the sick and wounded, their accommodation, their evacuation, and also for the supply of medical equipment and stores.

Under the direction of the medical service the troops will themselves take all measures necessary for the improvement of their accommodation. For instance, the construction and improvement of wells and other water supplies, and also of latrines; the construction of bath and disinfecting establishments; the removal of refuse; burial of the dead; burial of carcases. For the above purposes it may be advisable to employ the services of geologists.

Every unit has its medical officers, medical N.C.O.'s and men. In addition each infantry company has six stretcher bearers; each machine gun, minuenwerfer and pioneer company—four, and each battery two. The stretcher-bearers belong solely to the medical service. The other troops train men as auxiliary stretcher-bearers who, when ordered, carry out stretcher-bearer duties.

Every man in the Army carries two first field dressings. Every medical N.C.O. and stretcher-bearer has a medical wallet and water-bottle. Each medical officer has a case of instruments and first-aid apparatus. Infantry and pioneer battalions have one ambulance wagon with nine stretchers and one medical store wagon which has five stretchers, dressings, medicines and knapsacks.

Every squadron of cavalry has medical equipment and emergency

stretchers carried on pack-horses allotted to the medical service. In addition each cavalry regiment has a cavalry store wagon carrying two stretchers, medicines and dressings.

The other troops (*sic*) carry on their vehicles medical and surgical panniers, medical knapsacks and stretchers. The artillery units have, in addition, a special field wagon and special arrangements for transporting the sick and other medical equipment.

Blankets for the sick and body belts are carried in the baggage of all troops.

Medical Units.

Under this heading only three units are mentioned, viz., stretcher-bearer company, field hospital and motor ambulance convoy.

A stretcher bearer-company has three sections, and a single section may be attached to a small independent force. The company should only be divided in an emergency, as its efficiency is said to be greatly reduced when it is employed in separate sections. The idea of having the company divisible is not to facilitate the employment of separate sections, but to enable the main dressing station to be closed by the withdrawal of separate sections. Each section has three ambulance wagons, one medical stores wagon carrying medical and surgical supplies, one baggage wagon with a dressing tent, one field kitchen, one supply wagon. Each ambulance wagon can carry four stretcher cases and three sitting cases, or two stretcher and seven sitting cases, or eleven sitting cases.

A field hospital can be divided into two sections, each section has hospital equipment for 100 casualties.

A motor ambulance convoy consists of 12 motor ambulance cars, 1 motor lorry, 1 small motor lorry, 1 motor cycle and 5 trailers for motor ambulances. A motor ambulance can accommodate 4 stretcher cases, or 2 stretcher and 4 sitting cases, or 8 sitting cases. The trailer can accommodate 2 stretcher or 4 sitting cases.

Duties on the Line of March or when stationary in Billets.

When an independent unit is on the march a collecting station for sick and wounded should be formed and special instructions in operation orders should give its location and time of opening and closing.

It is also considered advisable to publish the location of the collecting station in the area to be occupied next day. Regimental ambulance wagons or those of the medical companies may be used with the sanction of the respective commanders, to transport the sick of troops on the march. In the case of an advance it may be advisable to allot a few motor ambulance cars to the troops in order to evacuate the sick as soon as possible. As soon as the sick have been evacuated or handed over to the line of communication, the medical personnel of the collecting station must rejoin their units without delay.

When a force remains for several days in the same locality, the troops

are to establish medical inspection rooms, and the headquarters of formations arrange for a local hospital; both as far as possible in the vicinity of civil hospitals.

During a retreat only the absolutely necessary medical personnel, generally of subordinate rank, is to be left behind, under the protection of the Geneva Convention, to care for the sick who cannot be evacuated.

Medical Organization during and after an Engagement in Mobile Warfare.

When during an engagement casualties occur the unit establishes regimental aid-posts, using for this purpose the equipment in the medical stores wagon and the medical and surgical panniers. Aid-posts must be inconspicuous, sheltered from rifle fire, as near as possible to the fighting area and easy of access, and have a good water-supply. The site should be on the road by which the advance took place, and the position should be communicated to the troops. Before an engagement the stretcher-bearers assemble at the medical stores wagon, and when ordered by the medical personnel leave their equipment at the aid-post and go forward with stretchers and medical knapsacks. The A.D.M.S. of the division and the medical companies are to be informed of the position of the aid-posts, so that the sick may be taken over or collected, the regimental aid-posts withdrawn, and the duties taken over by the main dressing station. If regimental aid-posts are not established or cannot be reached, "groups of wounded" are to be treated on the spot with the contents of the medical knapsack and it is a special duty in these circumstances to send information to the rear. A wound tally containing details of the nature of wound, fitness for transport, and notes of any fact of medical importance, is to be attached to a coat button of the wounded man.

The stretcher companies are not to be employed until the tactical situation permits of their continued and effective action at not too great a distance from the place where the casualties have occurred. They establish the main dressing station and its site should be made known to the troops. The combination of the main dressing station and the regimental aid-posts if possible by taking over the latter is desirable; a greater efficiency is thus obtained, and the medical personnel with the medical equipments of the troops can rejoin their units. Tent shelters of the fallen and wounded are used for the temporary immediate accommodation of the wounded on the battlefield.

Collecting stations for slight casualties (walking wounded) are to be formed from the medical personnel and the appliances of medical and other units. The site must not interfere with the movement of troops nor be near a field hospital, but it must be easy to find. Slightly wounded men report to their immediate commander, retain their arms, but hand over ammunition except a few cartridges and then proceed to the regimental aid-posts; here they are formed into parties and dispatched to the collecting station.

When an engagement is expected the field hospitals must be brought up in good time, they may move with the first line transport. The personnel of field hospitals that have not been established may be brought up to help at the aid posts and collecting stations for walking wounded. The senior medical officer of the field hospital in the neighbourhood is authorized to make such arrangements on his own responsibility.

If the tactical situation and local conditions permit the field hospital should take over the main dressing station.

After an engagement troops must bury the dead. Graves and sites for mass burial must not be located in villages, close to low-lying roads, in meadows, near springs or water courses, or in ravines. The bottom of a grave must be above the level of the ground water. Bodies must be covered with at least one metre of earth and mounds must be placed over flat graves.

Field hospitals should be able to follow their divisions without delay. If the sick cannot be evacuated and the hospitals closed they should be relieved by the next field hospital moving up, or by a war hospital detachment, which will convert the field hospital into a war hospital. Medical equipment which is left behind must be replaced by the war hospital.

If during a retreat the wounded cannot be evacuated in good time the minimum necessary personnel and equipment should be left behind with them.

The Evacuation of Sick and Wounded.

The wounded and sick are divided into those able to walk, sitting cases, stretcher cases and those not fit to be moved. Wounded not able to walk are carried from the aid-posts to the main dressing station by the ambulance transport of the troops and by the stretcher-bearer companies. Motor ambulances are primarily employed for the rapid clearance of main dressing stations or field hospitals to hospitals in the rear and to rail heads. Where possible they should also clear the regimental aid-posts. They are distributed by the A.D.M.S. according to requirements. Halting places for motor ambulances should be established and their location made known. At the demand of medical officers single wagons and columns returning empty must carry non-infectious sick or wounded, provided this does not prevent the wagons reaching their destination in good time, and they may deviate from their prescribed route in order to take cases to their destination, provided the change of route can be notified or no particular roads have been indicated. Responsibility for taking or leaving behind the wounded rests with the officer commanding the vehicles or column.

When heavy casualties are expected the medical detachment at General Headquarters organizes collecting stations at railheads and waterways. Hospital trains carrying 200 stretcher cases and auxiliary ambulance trains for sitting cases are provided for the evacuation of wounded. Hospital ships for cot cases and improvised ambulance barges for slight cases are organized into convoys. If cases have to be evacuated from places where

no collecting station has been established, the railway commandant must carry out the evacuation.

As the sick and wounded can seldom be removed at once to the home country, hospital detachments allotted to General Headquarters of the Army organize in back areas general hospitals for serious cases and convalescent depots for slight cases. Sick and wounded who have recovered in the zone of operations, but are not fit to rejoin their units, are handed over to convalescent companies in back areas to be hardened for service by graduated exercises.

Replenishments of Medical Supplies.

R.M.O.'s indent on the nearest medical company, field hospital or the A.D.M.S. as may be most convenient. Medical troops indent on the A.D.M.S. who has at his disposal medical store wagons and medical store depots. A medical store wagon can be sent to any required spot, such as a re-filling point, the site of which has been made known. In back areas medical store depots are organized for a group of higher formations.

During a Lull in Operations.

Regimental aid-post dugouts must be established as quickly as possible; large medical dugouts in which specialists can perform operations may be required when enemy fire prevents the evacuation of wounded. Routine measures for the evacuation of wounded must be elaborated; on field trainways special trucks for the carriage of wounded are to be got ready. Premises for field hospitals are to be prepared. Sanitary measures, such as the supply of drinking water, the management of latrines, the destruction of vermin, the establishment of bathing places are to receive immediate attention.

Neutrality Sign.

All members of the medical units of the field army and all other medical personnel, regimental stretcher-bearers, leaders of the medical pack horses, drivers of regimental ambulance wagons, drivers and attendants of motor ambulances, grooms of regimental medical officers and the personnel of voluntary aid societies, wear on their left arm a white armlet stamped with the neutral sign of the Geneva Cross, that is a red cross on a white ground.

Current Literature.—Pathology.

Memorandum prepared by Dr. Copeman on recent work in connection with the Bacteriology of Scarlet Fever, and Immunization Methods for Treatment or Prevention (Ministry of Health).—During my recent official visit to New York I was afforded opportunity of investigating work in progress on the bacteriology of scarlet fever, on methods of immunization, and on the specific treatment of individuals who have already contracted the disease. Work in these directions is now being

carried out at the Willard Parker Hospital on a considerable scale by Dr. Abraham Zingher, Assistant Director of the Public Health Department.

This work is largely based on what is known as the "Dick Test," so-called from its introducers, Drs. G. F. Dick and Gladys H. Dick, of Chicago —a test which exhibits analogies to the "Schick Test" for diphtheria.

Bacteriology.—In a series of recent papers the Dicks have set out the results of a lengthy study of the bacteriology of scarlet fever, in the course of which they confirm the earlier results of Klein, Tunnicliff, Bliss and Mervyn Gordon, that a hæmolytic streptococcus, long recognized as a micro-organism constantly present in the naso-pharyngeal cavities of all patients with scarlet fever, constitutes the probable etiological agent of the disease.

But considerable difficulty has been experienced in connexion with the work owing to the fact that it is impossible by the inoculation of guinea-pigs, rabbits, mice, or other laboratory animals to produce a disease bearing any definite resemblance to scarlet fever; consequently all recent experimental work on the subject has had necessarily to be carried out on human volunteers.

Examination of blood cultures also has failed to reveal any organism present constantly enough to indicate a causal relation, and the results of the subcutaneous inoculation of the volunteers with fresh blood serum and fresh whole blood from early cases of scarlet fever have been completely negative. This has also been the case as a result of experiments in the inoculation of volunteers in the throat, and subcutaneously with filtered throat mucus obtained from early cases of scarlet fever. As, however, these experiments might possibly have been invalidated owing to the individuals inoculated having previously suffered from an attack of scarlet fever, a further series of volunteers was obtained who had lived practically all their lives in the country, and concerning whom no history of attack by scarlet fever could be obtained. In this second series of human inoculations a typical case of scarlet fever was produced by swabbing on the tonsils and pharynx a pure culture of hæmolytic streptococcus isolated from a lesion on the finger of a nurse who acquired the disease while caring for a convalescent scarlet fever patient.

As, however, recent opinion has tended to the suggestion that a filterable virus might be concerned in the production of the disease, another group of volunteers was inoculated with the same culture after it had been passed through a Berkefeld V filter. These all remained well. After an interval of two weeks they were once more inoculated, this time with the unfiltered culture; forty-eight hours later one of them developed scarlet fever. As bearing on this point it may be mentioned that I learnt from Dr. Krumwiede, bacteriologist to the Public Health Bureau, that one of his assistants at the Research Laboratory recently contracted scarlet fever following the accidental swallowing of a culture of the hæmolytic streptococcus. From cultures of this streptococcus, of which there would appear to be two types, one of which is capable of fermenting mannite in culture, while the other does

not do so, the Dicks obtained a toxic filtrate from the condensation fluid of cultures of the organism on blood agar slants, the fluid being subsequently passed through a Berkefeld filter in order to obtain it free from organisms.

The " Dick Test."—This toxin, when suitably diluted, is now used for the purpose of the Dick test for determination as to the susceptibility of individuals to scarlet fever or the reverse; the test fluid being inoculated intradermally in precisely the same manner as the solution of diphtheria toxin in performance of the Schick test. The results following on the use of this test are also very similar to those observed in the case of the Schick test, except that the reactions appear more rapidly and subsequently fade more quickly. Dr. Zingher, who had kindly inoculated a number of children on the day previous to my visit to the Willard Parker Hospital, in order that I might see the results obtained, laid great stress on the fact that pseudo reactions are even more frequent than in the case of the Schick test, and that consequently a control inoculation on the opposite arm is of very special importance. The control test is carried out with a solution of the toxin which has been heated in a water-bath to boiling temperature for an hour, the toxin being less easily destroyed than in the case of the Schick toxin. A similar dose (0·2 cubic centimetre) of the toxin is employed as in the Schick test, and the results following on this use will be either (1) positive, (2) positive and pseudo, (3) negative, (4) negative and pseudo; the reddened area representing the positive result being of about the same area as is observed in a positive Schick test.

As bearing further on the specific effect of the toxin, it is found that when a patient, who has been inoculated intradermally, subsequently contracts scarlet fever, the area occupied by the previous positive reaction is marked as a pale area surrounded by the scarlet fever rash, which latter is specially intense in a narrow area immediately surrounding that previously occupied by the positive reaction.

The effect of the toxin can be completely neutralized by mixing with it blood serum obtained from a convalescent scarlet fever patient, or the serum of a horse which has been immunized with the toxin; furthermore, if serum from either of these sources be injected intradermally into the skin of a patient suffering from an early scarlet fever rash, a blanching of the rash over the area of the injection is at once produced. This is known as the *Schultz-Charlton* phenomenon.

Information afforded by the " Dick Test."—All patients coming into the Willard Parker Hospital, whether supposed to be suffering from scarlet fever or not, are now, as a regular matter of routine, inoculated with streptococcus toxin. Of the cases which definitely turn out to be scarlet fever, it is found that in the very early stage a positive Dick test may be obtained, whereas if the test be repeated about ten days later the result is usually negative. In a certain number of cases of mistaken diagnosis also a positive result will often be obtained, but again if, as not infrequently happens, a patient contracts scarlet fever after a stay of

some days in hospital, a negative test will be obtained after a corresponding interval of time.

As regards the reaction likely to be obtained following on the Dick test among children not suffering at the time from scarlet fever, very similar results have been obtained to those well known in connection with the Schick test. Thus, in the earliest stage of life a child apparently obtains fleeting immunity from the mother, so that up to the age of three months at any rate the Dick test is likely to afford a negative result. At subsequent ages the relative proportion of positive and negative results, as in the case of the Schick test, will develop according to age, to social status, and as to whether the child is town or country bred. In the case of many hundreds of children from congested slum areas in New York, Dr. Zingher finds that the proportion of positive Dick tests is about 32 per cent., whereas in children from better class areas, or from country districts, the proportion of positive reactions may be as high as 88 per cent.

Treatment of Scarlet Fever.—Like the Dicks and other subsequent observers, Dr. Zingher finds that the course of the disease in those who have already contracted scarlet fever can be modified and curtailed by the inoculation of blood serum from a case convalescent from the disease, or by the simpler procedure of using for this purpose citrated whole blood to the extent of double the amount necessary in the case of convalescent serum. Arrangements have recently been made, however, for the immunization of horses with streptococcus toxin, the anti-toxin serum obtained from which has been found to act as well or better than convalescent serum, and which will have the advantage of being much more readily obtainable.

Immunization.—Some thousands of children in hospitals or at infant welfare centres in New York, who have been found to give a positive reaction to the Dick test, have now been inoculated intramuscularly with scarlatinal hæmolytic streptococcus toxin. Again, as in the case of the Schick test, these inoculations have been three in number at weekly intervals. These, in the majority of instances, have not given rise to any serious reaction, locally or constitutionally. The amount employed for the purpose of these immunizing inoculations is based on the quantity of toxin used for the Dick test, children under twelve being injected with 100, 250 and 250 skin-test doses, while for persons over twelve years, 100, 250 and 500 skin-test doses have been employed, the toxin being so diluted that each cubic centimetre represents 500 skin-test doses, the initial dose therefore being 0·2 cubic centimetre.

In a small proportion of the inoculated persons constitutional symptoms, including a scarlatiniform rash, slight sore throat and elevation of temperature have been observed, these symptoms disappearing however in from thirty-six to forty-eight hours. In order to avoid the possibility of such reactions, Dr. Zingher and his colleagues are at present investigating the effects of using a toxin purified with formaldehyde, according to the

methods suggested by Glenny and Hopkins for the production of a toxoid from diphtheria toxin. Again, as in the case of the Schick work, it is important that the results of these inoculations, *qua* immunization, should be tested by the Dick method after an interval of three or four months from the last inoculation. Of 274 children recently retested in three institutions at an interval of from *four to five weeks only* after the last toxin injection, 167, or 61 per cent. showed they had become immune.

No child giving a negative Dick test on admission to hospital (the Willard Parker) has, thus far, contracted scarlet fever, even though bedded in the scarlet fever wards.

Experimental Scarlet Fever. By G. F. Dick and G. H. Dick (*Journ. Amer. Med. Assoc.*, 1923, vol. lxxxi, p. 1166).

A Skin-Test for Susceptibility to Scarlet Fever. By G. F. Dick and G. H. Dick (*Journ. Amer. Med. Assoc.*, 1934, vol. lxxxii, p. 265).

The Ætiology of Scarlet Fever. By G. F. Dick and G. H. Dick (*Journ. Amer. Med. Assoc.*, 1924, vol. lxxxii, p. 301).

Scarlet Fever Toxin in Preventative Immunization. By G. F. Dick and G. H. Dick (*Journ. Amer. Med. Assoc.*, 1924. vol. lxxxii, p. 544).

G. F. and G. H. Dick have produced scarlet fever in humans by swabbing the tonsils and pharynx of volunteers with an apparently pure culture of a hæmolytic streptococcus. At the same time, however, they do not conclude that all cases of scarlet fever are caused by the hæmolytic streptococcus. Later they found that filtrates of such cultures, when diluted and injected intracutaneously, caused a reaction similar to the Schick reaction in 41·6 per cent of persons with no history of scarlet fever. Patients convalescent from scarlet fever invariably gave a negative or very slightly positive reaction. If convalescent scarlet fever serum was mixed with the filtrate before injection, or given intramuscularly before the test was made, no reaction occurred.

Evidence is produced to show that scarlet fever may be caused by two types of hæmolytic streptococci—a mannite fermenter and a non-mannite fermenter.

Four cases are reported of persons with positive skin reactions who were injected intramuscularly with a larger dose of the filtrate from the culture of one of the hæmolytic streptococci. Within a few hours of injection all the patients developed a scarlatina rash, fever, nausea, etc., these symptoms disappeared after forty-eight hours and later the skin test was found to be negative. The incubation period of experimental scarlet fever was about forty-eight hours and the short interval between the injection and the onset of the symptoms described above suggests that the effect was produced by a soluble toxin rather than by a filterable virus. H. J. B.

The Dick Test in Normal Persons and in Acute and Convalescent Scarlet Fever. By Abraham Zingher (*Journ. Amer. Med. Assoc.*, 1924, vol. lxxxiii, p. 432).—This important paper is an account of the Dick test

with an analysis of results in over 4,500 young people. An account is given of the preparation of the pure toxin from hæmolytic streptococcus. At present there is not a very satisfactory method of standardizing the toxin, the method in use being the comparison of skin reactions with a standard diluted toxin. The technique of the test closely follows the lines of the Schick test. The toxin, however, being more resistent to heat than diphtheric toxin, has to be heated at 100° C. for one hour before it can be used as a control. A positive reaction comes on more quickly, and fades more quickly than in the Schick.

A positive reaction indicates susceptibility and a negative immunity. So far scarlet fever has only developed in positive reactors. A persistent positive reaction during a case of clinical scarlet fever to convalescence may be explained by a mistaken diagnosis or the existence of other causative toxins and bacteria.

The infection is a combined toxic and bacterial one, but immunization is antitoxic only.

The age and social status susceptibility for scarlet fever follow fairly closely those observed for diphtheria.

Natural active immunity was developed in ninety-three per cent of convalescent scarlet fever cases.

Artificial active immunity has been produced satisfactorily by means of the ordinary toxin injected subcutaneously, but work is in progress with a modified toxin prepared on the lines suggested by Glenny and Hopkins for the production of toxoid from diphtheria toxin which promises to give better results. H. J. B.

The Precipitin Diagnosis of Typhoid Fever. S. Costa, L. Boyer and L. Jaur (*C. R. Soc. Biol.*, xc, No. 12, April 4, 1924, p. 865).—The precipitin reaction is used for medico-legal purposes, but hitherto has found very little application in the diagnosis of infectious diseases. The authors have undertaken its study from this aspect, commencing with typhoid fever. The reagents used were:—

(1) The patient's serum.

(2) A culture of typhoid bacillus in broth which had been kept at 37° C. for three weeks and filtered through a Chamberland L3 candle. The superposition of layers of the two fluids in a test tube gave satisfactory results when undiluted serum was used, but not with diluted serum. The typhoid toxin was therefore mixed in equal parts with nutrient gelatine of neutral reaction, the mixture being effected by melting. The gelatine was allowed to solidify, and on the surface was placed one to two cubic centimetres of the serum to be tested. The tubes were kept at a temperature of 18° to 22° C. for eighteen to twenty-four hours. In the case of a positive reaction, a whitish granular film forms at the junction of the serum and the gelatine. This film adheres to the gelatine, and the serum can be poured off without disturbing it. The sera of twenty cases, proved to be typhoid either

bacteriologically or serologically, were tested by this method, which gave positive results in every case with a dilution up to 1 : 5 and usually up to 1 : 10. The reaction attains its maximum about the third week, but is obtainable from the first few days, in one case from the fourth day and in three cases from the sixth day, while the agglutination reaction was still negative.

Further Notes on Modification of Diphtheria Toxin by Formaldehyde. By A. T. Glenny, B. E. Hopkins and C. G. Pope (*Journ. of Pathology and Bacteriology*, 1924, vol. xxvii, p. 261).—The amount of formaldehyde necessary to produce this modification depends upon the amino-nitrogen content of the toxin. That is, a toxin having a high Van Slyke value requires more formaldehyde to prevent a dermal reaction than a toxin having a low nitrogen content. Temperature and the length of exposure also influence the reaction. At temperatures from 30° to 39° C. the modification progressively increases. A toxin containing 0·4 per cent. formalin took nine days at 30° C. before a negative intradermal reaction was obtained from undiluted material.

The addition of varying quantities of formalin to a toxin alters only very slightly its combining power with antitoxin, but the rate of the reaction is definitely reduced. As a result of modification of toxin many of the tests for combining power can no longer be made, and here Ramon's flocculation test becomes invaluable. There is evidence to show that there may be present in a diphtheria toxin much non-specific toxin, and that the larger doses of formalin required to modify such toxins may reduce the affinity of modified toxins for antitoxins. But by a process of precipitation of toxins by one to three per cent glacial acetic acid, toxins and even modified toxins may be purified and concentrated. And this modified concentrated toxin has a much greater antigenic value than toxin-antitoxin mixtures. Further, if an immunizing mixture of modified toxin aud antitoxin be used it is found that the amount of antitoxin, within wide limits, does not affect the antigenic power. It has been found possible by means of a single injection of modified concentrated toxin, to produce Schick negative guinea-pigs in eleven days. H. J. B.

Observations on the Agglutinins in Typhoid Fever. By F. M. Burnet (*Brit. Journ. of Exper. Pathology*, 1924, vol. v, p. 251).—The author examined a serum from a patient suffering from typhoid fever against an emulsion of *B. typhosus* grown in ammonium oxalate broth and also against a normal standard emulsion. The first emulsion was agglutinated into small compact granules, whilst the second was agglutinated into large loose flocculi. The author thinks that the oxalate broth produces a type of bacillus which corresponds to Arkwright's R-type, and that ordinary broth a type which corresponds to the S-type. These two types, inoculated into animals, resulted in the production of specific agglutinins, spoken of as R and S respectively. S-agglutinogen provokes almost equal

amounts of R and S-agglutinins, but practically only R-agglutinins are produced with an R type.

In nearly every case of typhoid fever both agglutinins may be demonstrated. Usually the R-agglutinins are in excess of the S. In the case of active immunization produced by means of prophylactic use of vaccines, however, the S-agglutinins predominate and only a trace of R-agglutinins can be found. This phenomenon may have some importance in the diagnosis of typhoid fever in inoculated subjects. H. J. B.

Reviews.

GOITRE. A CONTRIBUTION TO THE STUDY OF THE PATHOLOGY AND TREATMENT OF THE DISEASES OF THE THYROID GLAND. By F. de Quervain. Translated from the French by J. Snowman, M.D., M.R.C.P. London: John Bale, Sons and Danielsson. Pp. xii+247. Price 21s. net.

This book is a comprehensive treatise on goitre by Professor F. de Quervain, of the University of Berne. It is not a large volume, containing only 247 pages, but its seventeen chapters deal with every aspect of the subject. It is a notable addition to the literature of the thyroid gland and its diseases.

The surgical anatomy and the physiology of the thyroid are first discussed, followed by causes of goitre, pathological anatomy of goitre, and the pathological physiology of the thyroid. Diagnosis, prophylaxis, and non-operative treatment each form separate chapters, and the operative treatment of goitre is then entered upon.

Post-operative treatment, prognosis, operation in relapse and in inflammatory conditions, are discussed, followed by chapters on malignant goitre, thyroid deficiency, hyperthyroidism and exophthalmic goitre, and combination of hypothyroidism with hyperthyroidism.

The volume is well translated and contains a bibliography. It is profusely illustrated. The elementary aspects of the subject are omitted, and Professor de Quervain's work, summarizing as it does the teaching of the Berne school, is a co-ordinated and compact treatise which deals thoroughly with the whole subject of goitre, as far as this subject is understood at the present day. M. B. H. R.

AN OUTLINE OF ENDOCRINOLOGY. By W. M. Crofton, B.A., M.D. Edinburgh: E. and S. Livingstone. 1924. Pp. vii+150. Plates 18. Price 6s. Crown 8vo.

In this handy little book there are nine chapters dealing respectively with the pineal, pituitary, suprarenal, thyroid, parathyroid, thymus and sexual glands; the pancreas and the hormones of the intestinal tract.

Each chapter presents a short concise account of the history, physiology, pathology and the anomalies of function of the gland under review and concludes with a condensed and practical account of its use in therapeutics.

The chapter on the thyroid gland and that on the pancreas are written more fully; the latter is somewhat disappointing, and probably few readers will agree with the author's view regarding the treatment of diabetes with the preparations that were in vogue before the discovery of insulin. The chapter ends with "Theoretical Considerations," which seem rather an intrusion.

A chapter on the hormones of the gastro-intestinal tract presents a brief well-balanced summary of what is known about these obscure secretions.

The last and tenth chapter is a short epilogue in which the influence of internal secretions in general is sketched, perhaps rather too hurriedly.

Several printing errors were noticed scattered throughout the book.

We commend the book for what it purports to be, that is, an outline of the present knowledge of endocrine glands and a practical guide for their therapeutic use. A. E. H.

ORATIONS AND ADDRESSES. By Sir John Bland-Sutton. London: William Heinemann, Ltd. 1924. Pp. xii + 161. Price 10s. 6d.

The vivid descriptions and clarity of diction of these essays recall the works of the great medical writers of the last century, and afford a pleasant relief to the crabbed style of so many modern textbooks.

Their subjects range from an historical account of the life and work of John Hunter ("The Hunterian Oration of 1923") to "The Shrunk Heads of Head Hunting Indians and the Habits of Tumours." Sir John's interest in all that pertains to medical science is as wide as Hunter's own; but he brings to his writing a more facile pen. His descriptions create a mental picture of the anatomical part or condition described, and are worth much reading of textbooks.

The address on "The Surgeon of the Future" and the essay on the "War Pathological Collection of the Royal College of Surgeons" should appeal particularly to Service officers.

The papers included in the volume are tantalizing. They leave the reader with a desire to know more on each subject, and a wish that they were not so short and condensed. Perhaps this was the author's intention.

HANDBOOK OF SKIN DISEASES. By Frederick Gardner, M.D. Edinburgh: E. and S. Livingstone. 1924. Pp. 248. Price 10s. 6d.

This book as its name implies is simply a short account of the more common diseases of the skin.

The author does not adhere to any of the recognized classification systems — the whole being founded on his course of lectures. His descriptions and methods of treatment are dealt with on very sound lines

and display a thorough knowledge, evidently the result of long practical experience.

The last chapter on Syphilis and the Syphilides is perhaps unduly short and sketchy.

In practice we have not found the Wassermann reaction so unreliable as is the author's experience, and if efficiently carried out there can be few instances when it is negative in the secondary eruptive stage.

As regards treatment of syphilis, we have found the best arsenical preparations to be of no less value in the later stages than in the early.

In this edition there are twelve coloured plates—some of these do not appear to be convincing. The letterpress is excellent and the book very readable. There is an appendix of useful prescriptions in addition to the many valuable ones throughout the context.

METHODS IN MEDICINE. By G. R. Hermann, M.D., Ph.D. London: Henry Kimpton. 1924. Pp. viii + 521. Price 30s. net.

A solid book of over 500 pages, representing a complete manual and practical guide for the medical staff of a large civil institution; "Methods in Medicine" is, in fact, the standing orders of an American hospital. The first part of the book is devoted to administrative methods, rules and regulations, detailing the duties of the resident staff with regard to history-taking, routine examination of patients, laboratory work, general, clerical and miscellaneous duties. Then follow the special methods of clinical and laboratory investigation, therapeutics, dietetics with practical diet lists, emergency measures, and a chapter on the advantages of using few drugs—"Dock's twenty drugs." The last chapter, entitled "The history in order," contains a complete record of charts, diagrams, history sheets, curves and other forms of records employed in a large American hospital. Compared with the clerical work of a military hospital, that of the civil institution is immense; but when dealing with formidable numbers of serious or obscure cases, and employing every form of scientific investigation, an elaborate system of statistical organization is essential in order that records of cases may be complete; otherwise, they are likely to be valueless. Paper work in connexion with the modern means of diagnosis and treatment of large numbers of serious cases is an essential feature that cannot be dispensed with, however irksome it may be.

The book is a valuable contribution to an aspect of medicine that will probably receive more attention in the future than it does at the present day; organization and method, applied to the scientific work that now forms such an important part of diagnosis and treatment, constitute a branch of medical administration which will undergo a process of development later on.

Anyone wishing to study the professional organization of a big general hospital will find everything detailed in this comprehensive book.

M. B. H. R.

THE MODERN DIAGNOSIS AND TREATMENT OF SYPHILIS, CHANCROID AND GONORRHŒA. By L. W. Harrison, D.S.O., M.B., Ch.B., M.R.C.P.E., Brevet-Colonel R.A.M.C., and K.H.P. (Ret.). London: Constable and Co., Ltd. 1924. Pp. viii + 167. Price 10s. 6d.

This work, as the author states in his preface, is an attempt to provide busy practitioners with a reliable guide to present-day knowledge of these diseases in an easily assimilable form. It covers the ground in twelve chapters and 160 pages. There is one excellent coloured plate with descriptive text as a frontispiece and seven illustrations of instruments throughout the text. The author is to be congratulated on the success of his effort. The work is crammed full of information and clear instructions for diagnosis and treatment are given. It is eminently a practical survey, Chapters III and IV on the Diagnosis of Syphilis being especially lucid in such a condensed form.

It can be confidently recommended as a short, masterly and practical exposition of the subject devoid of all methods that have not stood the test of experience.

The letterpress is very good. There is one obvious printer's error, p. 147, line 23; the word "irritating" *should read* "irrigating."

THE THEORY AND PRACTICE OF THE STEINACH OPERATION. By Dr. Peter Schmidt, with an introduction to the English Edition by J. Johnston Abraham, C.B.E., D.S.O., M.A., M.D., F.R.C.S. London: William Heinemann, Ltd. 1924. Pp. xvi + 150. Price 7s. 6d. net.

Steinach, biologist and laboratory worker, experimenting on sex glands of rats, which he used because they possessed certain advantages over other animals, deducted from his experiments that the hormones governing sex instincts and characteristics were manufactured in ovaries and testes when implanted in castrated or spayed subjects; as a corollary these hormones existed normally in ovaries and testes of intact animals. His next step was to find out in what part of the respective gonads the hormones were produced, and his conclusion was that the male hormone was manufactured in the interstitial cells, and was not a by-product of the spermatogenic cells.

He therefore tied the vasa deferentia and thus caused the spermatogenic cells to atrophy. The result was an increase in the interstitial cells; furthermore, instead of eunuchism following ligature of the vasa in decrepit old rats, they took on a new lease of life and became once more agile, pugnacious and fatter. A new element was present—rejuvenation—and the next step was to apply his results to man. Hence Steinach's operation, which consists of unilateral vasoligation.

In the results recorded in this book, too much attention has been given to increase in sexual potency among those who have undergone the operation, and this fact tends to lessen the value of the work when translated into English. Details are given that will carry little weight with English

readers, and the book should not stray from the custody of the scientifically minded. In the case of at least one of the eighty-four individuals whose benefits from the operation are recorded, the interests of the general public might have been better served by the performance of an operation more radical in nature than vasoligation. However, marked physical and mental rejuvenation is stated to follow vasoligation in selected cases, and this improvement has remained for five years at least.

The book presents an authoritative survey of Professor Steinach's and practice, together with a reasoned summary of the results of the theories operation, and a bibliography. M. B. H. R.

Correspondence.

DIPHTHERIA IN SECUNDERABAD.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

Sir,—Captain S. Smith in his article on "Diphtheria in Secunderabad" in the October Journal describes a most interesting case of a young soldier who died from a disease very similar to the acute form of beriberi.

It was suggested that, as the patient had been on a generous diet, and as also the external ocular muscles were affected, the condition was possibly due to the K.L. bacillus and not to beriberi.

Ocular paralysis however occurs in beriberi, and in this connection the following extract from Colonel Elliot's lectures on "Tropical Ophthalmology," 1920, Oxford University Press, may be of interest. In detailing the eye conditions associated with this disease he states:—

"Paresis of the ocular muscles is met with in this disease. The external rectus is that most often affected."

Such a sporadic case of acute beriberi, occurring under the circumstances related in the article, would be of very great interest indeed.

I am, etc.

Balham, S.W. William H. Dye,
November 4, 1924. *Captain, R.A.M.C.*

NOTES ON RECRUITS.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

Sir,—I have been enabled to add to the figures regarding the development of recruits published in my "Notes on Recruits" in the October number of the Journal by a collection of similar data from the same regimental depots as those previously referred to, and extending over a further period of six months. The following results refer to the whole period of one year.

Of 351 men drafted to their battalions, the average factor (Balcke-Foote's modification of Pignet's factor) at the time of enlistment was 94·13, and at the end of their period of training in the depot, 103·70; or, taking the figures in detail for 283 of these men, the average chest circumference, height and weight on enlistment was 35·05, 65·20, and 124·09, and on the completion of training, 35·82, 65·92, and 133·71 respectively—measurements being in inches and pounds.

It will be noted that the individual measurements are smaller than those given in my paper, which were, after all, for very small numbers, but the general build of those recruits who survive training, as calculated from these measurements, remains practically the same.

I am, etc.,
R. A. MANSELL,
Captain, R.A.M.C.

R.A.M. College, London,
November 7, 1924.

THE COMPARATIVE COST OF LIVING IN LONDON AND IN INDIA.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—We are all, I believe, born "grousers," and perhaps the commonest subject for a "grouse" at present is *Pay and Cost of Living*, especially among married officers.

Having done a five years' tour of duty in India since the war, and having now served at home for just a year, it has interested me to compare the cost of living for a married officer at home and in India. I have therefore worked out a comparative set of figures which I give below, in the hope that it may be of interest to brother officers, and especially junior married Captains like myself. The figures may not be accepted by everyone and may prove controversial, but I can only say that they are neither fictitious nor the fruit of a "chronic grouser's" imagination, but are worked out from my own actual experience in consultation with my wife, round figures being given for convenience.

The figures only include actual necessities of life, and I have not allowed for amusements or social amenities, nor have I made any provision for clothing for oneself and one's family, nor for tobacco and "drinks."

If the figures given appear exaggerated or unduly high, this may perhaps be explained by the fact that my last station in India (to which the figures refer) was an expensive seaport city with a large civil and military European population, and the home station is London. No doubt the figures would be smaller in a country station at home, or an "up-country" station in India, but this does not alter the comparative value, in fact it would probably only emphasize it, as the reduction would be greater in India than at home.

I would add that my family consists of myself, my wife and two small children, one of whom was born after we arrived in England.

ACTUAL COST OF LIVING PER MONTH.

In England.		*In India.*	
Rent and furniture .. .. [1]	£17 0 0	Rent and furniture .. .. [5]	Rs. 160
One nurse's wages	4 0 0	Servants .. .. [6]	220
One servant's wages	4 0 0		
Light and heat .. .. [2]	3 0 0	Light, fans and taxes	20
Laundry	3 0 0		
Dairy	4 0 0	Dairy	40
Food .. .. [3]	10 0 0	Food .. .. [8]	150
Incidental .. .. .. [4]	7 0 0	Incidental .. .. .. [7]	30
Total ..	£52 0 0	Total ..	Rs. 620

Notes :—

[1] Furnished flat at £4 4s. per week.

[2] Winter.

[3] Including "stores."

[4] Including Mess bill, lunches in Mess or out, and fares to and from duty.

[5] Rent of bungalow Rs. 120
Hire of furniture Rs. 40

[6]

Butler-bearer ..	Rs. 45	Mali ..	Rs. 20
Cook	40	Sweeper ..	15
Ayah	40	Bhisti ..	12
Masalchi ..	25	Mehtani ..	5
Dhobi	18		

[7] No allowance made for Mess bills or Clubs.

If this be compared with the present rates of pay, we find :—

In England.		*In India.*	
Pay and allowances (winter)	£60 0 0	Pay (after deducting income tax)	Rs. 850
Cost of living	52 0 0	Cost of living	620
Balance credit ..	£8 0 0 (= Rs. 120)	Balance credit ..	Rs. 230 (= £15 0 0)

The comparison would, I think, be even greater were an "up country" station in India taken, as in this case the figures for rent and furniture and servants would be reduced by certainly Rs. 20 and Rs. 40 respectively. The above figures are given only as a statement of fact and from the point of view of interest; I offer no comment on them, nor on the advantages or disadvantages of serving in England or in India at present; possibly the figures speak for themselves, especially if one considers what value one can get for one's money in the way of amusements and social amenities in the one country as compared with the other!

London,
November, 1924.

I am, etc.,
"MARRIED CAPTAIN."

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

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Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

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ASSISTED BY

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Journal of the Royal Army Medical Corps.

Original Communications.

NOTES ON MEDICAL RECRUITING.

BY LIEUTENANT-COLONEL R. V. COWEY.
Royal Army Medical Corps.

AND

BREVET LIEUTENANT-COLONEL C. R. SYLVESTER-BRADLEY.
Royal Army Medical Corps.

(1)

ONE of the most important and difficult duties a medical officer of the Corps may be called upon to perform is the medical selection of recruits for the Army.

The maintenance of a voluntary Army is dependent on a regular supply of recruits to make good its wastage in personnel, and if this wastage is accentuated by the introduction of recruits who are liable to break down under the stress of training, or service, a vicious circle is started, and the efficiency of the Army is bound to suffer.

An important point to remember is that the medical examination of recruits is not confined to the selection of only those who are normal in every respect. If such were the case we should soon have no Army. A voluntary Army must fashion its demands for personnel to the available supply, and it is due to the fact that the supply of what we may term "normal men" is unequal to the demand, that it has been found necessary to introduce physical and medical standards based on the maximum degree of physical or medical abnormality with which a recruit may be enlisted without undue loss of efficiency; at the same time, it must be realized that the elimination of inefficients is already very high.

(2)

If we trace the history of a hundred men presenting themselves for enlistment, we find that about fifty of these are rejected by the recruiters

and recruiting officers for obvious medical and physical disabilities or purely military reasons, and that some forty per cent of the remaining fifty are rejected by the examining medical officer. Of the 30 who are passed medically fit, it is estimated that from 4 to 8 are not finally approved on account of unsatisfactory character, under age, etc., so that 22 to 26 only arrive at the depot, where a further 1 to 2 are discharged under six months' service on medical grounds, and approximately the same number by the Commanding Officer as not likely to become efficient soldiers.

In addition, there is a further wastage in the case of Cavalry, Royal Engineers, Royal Corps of Signals, Rifle Brigade, R.A.M.C., etc., where the final approval of the recruit rests with the Commanding Officer of the unit. The Commanding Officers can refuse any recruit whom they consider not fit for the duties of the Corps, and when these recruits are returned to the recruiting branch they usually refuse to join any other Corps and are lost to the Service.

The final result being that approximately only sixteen of the original hundred become trained soldiers.

With the present type of recruit, our experience tends to show that an average rejection rate below thirty-eight per cent means the acceptance of undesirable recruits, whilst an average rejection rate of over fifty per cent suggests a too pessimistic view being taken of minor defects.

(3)

Although the efficiency of the medical examination of recruits on enlistment is important, the question of their discharge under six months' service is still more so. When it is realized that the average cost to the State of each recruit discharged on medical grounds has been as high as £50, and that last year 2,460 recruits were discharged, costing £123,000, more or less, the interest in this question is readily understood.

(4)

The most frequent cause of rejection on medical grounds during the last recruiting year for which statistics are available, e.g., 1921-22, was "defective vision."

This disability accounted for no less than 52·2 per thousand of the total rejections for the year, and is a record so far as medical rejections are concerned.

Defective vision has always been a frequent cause of rejection; in 1862, 26 per thousand were rejected; in 1872, 45·4; in 1882, 35·6; in 1892, 42·33; in 1902, 39·23; and in 1921, 21·08. This wide variation in the ratio of rejections may be accounted for to some extent by variations in the standards of vision that have been laid down from time to time. In 1862 the minimum standard is said to have been R = $\frac{6}{8}$, L = $\frac{6}{60}$. In 1912 the minimum standard for infantry was $\frac{6}{24}$ with each eye without glasses. In 1922 $\frac{6}{18}$ with each eye without glasses, provided that with the

aid of glasses the sight could be improved to $\frac{6}{6}$ and $\frac{6}{12}$. Recently the standard has been fixed at $\frac{6}{18}$ each eye without glasses.

Although defective vision causes such a high ratio of rejections on enlistment, and in spite of the fact that the standard for the acceptance of a recruit is so definite and the medical examination therefore easy to carry out, this disability is responsible for a large number of recruits being discharged during their training.

In 1912, 18 or 0·38 per thousand were discharged under three months service for defective vision; in 1922 (the period during which a recruit could be discharged had been increased to six months) the discharges under this heading had gone up to 207, or 2·67 per thousand. The only reasons that can be ascribed for this increase, apart from the lengthening of the period within which a recruit may be discharged, are careless medical examination on enlistment, and malingering on the part of a recruit after enlistment.

It is important for all medical officers to remember that when the recruit appears before the medical officer on enlistment, he wants to join the Army, and he will adopt every means to conceal any disability from which he may be suffering; if his vision is defective he will do his best, if given the opportunity, to learn the test types, and it sometimes requires the exercise of a considerable amount of patience and care before the medical officer can satisfy himself as to the recruit's correct vision.

After the recruit has been at the depot for a few weeks, his views may have altered completely. His ambition to join the Army may have changed to an all-absorbing desire to get out of it, and the most frequent method adopted to this end is to report sick and feign disease, or exaggerate some minor disability with which he has been enlisted in the hopes of getting his discharge on medical grounds. On this account it is important that medical officers should be most careful in recording a recruit's vision correctly, and never enlist a recruit unless they are convinced that he is up to the standard. Furthermore, when a recruit reports sick, and complains that he cannot see, it is up to the medical officer of the depot to look up the man's medical history sheet and ascertain what his vision was on enlistment. In nine cases out of ten, if a recruit reports sick for defective vision, and fails to read up to the standard shown on his medical history sheet, he is malingering, and should not be discharged on medical grounds because he states he cannot see.

Cases similar to the following illustration which actually occurred are frequent.

A recruit read $R = \frac{6}{6}$, $L = \frac{6}{6}$, on enlistment; again $R = \frac{6}{6}$, $L = \frac{6}{6}$, on re-examination at the depot. A few weeks later he would only read $R = \frac{6}{24}$, $L = \frac{6}{24}$, and was certified by a specialist as reading only $\frac{6}{24}$, $\frac{6}{24}$. After certain disciplinary action he again read $\frac{6}{6}$, $\frac{6}{6}$, with each eye. Eye specialists in some instances have carried out simple visual tests only, and have not examined the eyes after the use of a mydriatic. It is of the

utmost importance in doubtful cases that examination of the media and fundus oculi should never be omitted.

(5)

Another disability which is of increasing importance in recruiting work is "otitis media." In 1882, only 0·62 per thousand of those rejected were suffering from this disability, but by 1912 the ratio had increased to 8·08, and in 1922 it was 15·53. This increase is supposed by some to be due to a greater incidence of the disease in the general population, but if those who can remember the perfunctory examination of the recruits' ears in pre-war days will compare it with the more elaborate auroscopic examination which is the regulation now, they will readily believe that the increase of rejections is due to the more careful and exacting examination.

Most of the reports on the "Health of the Army" prior to 1912 have drawn attention to the gradual increase in the number of rejections from this cause, and we have the additional evidence of the increased number of discharges of recruits for the same reason whilst undergoing their training. In 1912, 1·23 were discharged under three months service for middle ear disease, in 1922 (the length of time within which a recruit could be discharged had increased to six months) the ratio of discharges had risen to 4·01. Furthermore, the ratio of soldiers invalided for middle ear disease has increased from 0·59 in 1913 to 3·08 in 1921.

It is suggested that the increase in the number of recruits discharged and in the number of soldiers invalided is due to the fact that nearly all cases of "otitis media" are now discharged from the Service, whereas formerly a man with a "running" from his ear was treated as an out-patient, had his ear syringed occasionally, and carried on with his duties quite satisfactorily.

Attention having become focused on this disability, it is desirable to invite consideration of a few of the problems underlying the subject. One of the chief difficulties connected with fixing a standard for the rejection of a recruit, or for the discharge of a soldier with middle ear disease, is that of getting aural specialists to think alike. Nobody at the present time would advocate enlisting a recruit with a purulent discharge from his ear or even with a definite perforation, but what is to be the line of action with regard to the clean and healthy scar of a healed perforation? One specialist may say that the conditions which produced the perforation have passed and are not likely to recur; another may point to enlarged tonsils or possibly a deflected nasal septum and say that any slight exposure or infection of the nasopharynx is likely to cause a recurrence. Then again, with regard to the discharge of a recruit or the invaliding of a soldier for this complaint, there are some who will say, "Too much attention is being paid to a minor disability, a slight discharge from the ear does not affect a man's fighting efficiency, and by invaliding a soldier with chronic otorrhœa you are throwing away all the money which has been spent on his training on

account of a disease which only rarely becomes a serious disability, and which normally should be treated in the out-patient department of the hospital.

In our opinion, a man with a clean healed perforation or old catarrh, provided that he has no nasal obstruction, adenoids, enlarged tonsils or deafness, should be accepted. This subject has recently been occupying the attention of a War Office Committee, and whilst their findings are not common property as yet, the following line of action is recommended. No recruit should be enlisted who suffers from any of the following defects: deafness, aural discharge, perforation, radical mastoid operation, dermatitis of the meatus. Conditions which after the removal of cerumen prevent a thorough examination of the ear (atresia of the meatus, etc.).

Conditions giving a history of recurrent earache, deafness, tinnitus or vertigo which cannot be accounted for by the state of the upper air passages.

The examination will consist of:—

(*a*) The removal, if necessary, of all cerumen.

(*b*) Auroscopic scrutiny.

(*c*) Testing the recruits' hearing.

(1) The recruit must be able to hear an ordinary whispered question put to him by an examiner standing six feet behind his back.

(2) In cases of doubt the following test must be applied. In a quiet room with each ear sealed in turn, the recruit must be able to hear a series of numbers including at random intervals the figures 66 (high note), 25 (medium note), and 44 (low note), uttered in the strongest whisper with residual air at twenty paces distant. This test gives the minimum standard of hearing.

(6)

According to our statistics of recruiting, "flat foot" would appear to have become more prevalent of late years.

In 1862 "flat foot" was not considered of sufficient importance to merit mention as a separate disease, but in 1872 the ratio of rejections for this disability was 6·66, since when there has been a more or less steady increase until in 1922 the ratio was 26·99. Furthermore, whilst the ratio of discharge within three months' service in 1912 was 0·77, in 1922 2·03 per thousand were discharged within six months of enlistment.

This increase may be due to a variety of causes. The incidence of flat foot amongst the general population may be on the increase, although in view of the less strenuous conditions of modern life this is highly improbable. Medical officers may be more careful to eliminate cases of flat foot than they were formerly, or medical officers may have altered their views as to the degree of flat-foot which is a bar to efficiency. Whatever view may be taken of the cause of the increase, it is important that the medical examiner of recruits should possess, if possible, some

uniform standard which will guide him. Unfortunately it is very difficult, if not impossible, to lay down a definite minimum standard of flat-foot.

The visual test is not always a sure guide; many "fit" individuals have flat foot from a visual point of view. Others, whilst showing a small loss of arch, suffer from a high degree of incapacity. The visual flat-foot may be due to the formation and laxity of connective tissue between the heel and the ball of the great toe, and not to a lowering of the bony arch. This condition is common amongst seamen and agricultural labourers and is not usually a sign of weakness.

The classical "Charlie Chaplin" gait in flat-foot cases is, however, a bar to enlistment. Other symptoms which should cause rejection on enlistment are:—

(1) Inability to hop.

(2) Failure to restore the arch on standing on tip toes.

(3) Actual collapse of the bony arch.

Inability to hop, although a bar to enlistment, is not necessarily a cause for discharge, as this condition in a recruit proposed for discharge for flat-foot is usually a manifestation of malingering.

One of the surgical symptoms of flat-foot is said to be tenderness behind the scaphoid bone. This is of little practical value in recruiting as no recruit desirous of entering the Service will admit anything detrimental to his chances of being passed fit, and all recruits anxious for discharge for flat-foot will complain of acute tenderness.

Recruits enlisted with moderate degrees of flat-foot are likely to have the condition aggravated during the early days of their training, especially is this likely when the training consists of too much standing. Heel and toe exercises are not advocated as a cure because they are likely to still further fatigue over-tired muscles. As a preventative and cure, the raising of the inside of the recruit's boot in the following manner is suggested.

Correction of the boot consists in raising both heel and sole on the inner side by one third of an inch and extending the heel forward on the inside by ¾ inch. The correction should not be a patch, but an insertion into the leather of the sole and heel, so as to become an integral portion of the boot.

It should be recognized that flat-foot is a preventable condition, and if caused or aggravated by training the training is to blame.

The principal defects in the training of the recruit at the present time are the following:—

(1) Too much and prolonged standing.

(2) Walking with the toes turned out.

(3) Standing with the toes turned out in the position of attention.

(4) Stamping.

(5) The hard non-resilient floors in some gymnasia.

Remedies for the above are as follows:—

(1) Reduce parades for recruits to thirty-five minutes from fall-in to dismiss.

(2) Walk with feet parallel.

(3) Stand to attention with the feet parallel and four inches apart.

(4) Abolish stamping which is very injurious to the feet. The hard non-resilient floors of gymnasia are gradually being replaced by wood planking, which should have a beneficial effect in reducing strain and injury to the feet.

The present position of attention no doubt throws a considerable strain on the immature feet of the recruit as the weight of the body is thrown directly on to the bony arch.

In the words of Sir Robert Jones, "Considering one foot by itself, the weight of the body rests upon a half dome, touching the ground at its outer border. It is stable if the body weight is so balanced that it rests on its outer edge, but if the body weight falls too near the inner side of the half dome, there is a tendency for it to capsize inwards."

There will be considerable opposition to the suggested method of walking and the position of attention as being less smart and contrary to military tradition. It is, however, a curious fact that prior to 1792 the feet were held a pace apart in the position of attention.

(7)

Disordered action of the heart is a condition causing many difficulties in recruiting work. As it is being reported upon at the present time by a War Office Committee, it is undesirable to go deeply into the matter here. Until a satisfactory exercise tolerance test has been worked out, the following plan may be adopted.

A recruit should not be enlisted whose pulse rate is over 100 after sitting in a chair for five minutes. A recruit should not be discharged from the service for D.A.H. until after admission to, and thorough testing in hospital. The pulse rate may vary from day to day, and after pay day, when an extra supply of cigarettes may have been smoked, the rate may be largely increased.

(8)

Only those disabilities which are shown by recruiting statistics to be an increasing cause of rejection and discharge have been dealt with so far; there is some consolation, however, in the fact that fewer recruits are rejected for varicose veins and varicocele than was the case in former years. In 1862, the ratio of rejection for varicose veins was 20·62, in 1922 it was 11·22. In 1902 the ratio of discharges under three month's service was 0·87, in 1922 0·55. In the same way varicocele has decreased from 16·82 in 1872 to 10·47 in 1922. Neither of these diseases can have been affected very much by standards of fashion, and the evidence tends to indicate a decrease in the incidence of these disabilities in the general population. This is due possibly to the present generation living a less strenuous life than their fathers and grandfathers. It is not necessary to dilate upon the medical examination of a recruit suffering from these dis-

abilities, every case has to be dealt with on its merits from a medical and surgical point of view. It is not advisable to enlist any recruit who needs, or is likely to need, operation. An operation directs the attention of the recruit to a disability which he may use to his own advantage at some future date, apart from any question of prognosis after operation.

(9)

The number of sound opposing teeth necessary to efficiency in a recruit has been always a subject of considerable divergence of opinion, and the many different standards that have been in vogue from time to time are reflected in the wide variation in the ratio of rejections which have occurred for defective teeth during the past sixty years.

In 1882, the ratio of rejections was only 7·93; in 1902, it was 49·26; in 1912, it was 22·44; in 1922, this disability ranked second as a cause of medical rejection on enlistment with a ratio of 49·98. The varying teeth standards which have been in force at different times may be attributed in part to the fact that recruits with particularly fine physique often have bad teeth and it has been argued that if the health of the recruit has not suffered from the effect of his teeth at the time of enlistment, there is no reason why he should not prove an efficient soldier in spite of his defective teeth. Whilst there is an element of truth in this assertion, the tendency at the present time is to pay more and more attention to the teeth as a cause of ill-health. This has resulted in the formation of the Army Dental Corps and a stricter standard of dental efficiency on enlistment.

With regard to the present dental standard, it is important for medical officers to realize how it originated. It may be accepted as an axiom that the degree of loss of teeth, and the number of decayed teeth with which a recruit may be accepted, is limited only by the amount of dental treatment the Army is prepared to carry out. As the establishment of our Dental Corps is a fixed one, a dental standard had to be laid down; and this standard is based on the assumption that if no recruits are accepted with a lower standard of teeth than the one in force, the Dental Corps should be able to carry out any conservative dental treatment necessary during the soldier's period of service.

Although the dental standard appears to be a simple one requiring only a dental mirror, good light and a simple addition sum, to carry it out, it has been a serious stumbling-block to many examining medical officers, owing to the large number of border-line cases which occur. Cases in which opposing teeth are carious, and there is a question as to whether they can be saved by conservative treatment, or cases in which the bite is abnormal, or the deciding teeth in the upper and lower jaws only partly oppose each other. In such cases, provided the opinion of a dental officer is not available, the examining medical officer must use his own judgment. It is fairly obvious that the standard laid down should be a definite one, so as to reduce the divergencies of opinion to a minimum; otherwise one medical

officer accepts a recruit as being fit enough for the Service, and after he has been clothed, fed, and paid by the State, another medical officer sees him and turns him down, for not having, in his opinion, sufficient teeth.

(10)

A very favourite method adopted by recruits in order to obtain their discharge is that of "bed wetting." Frequently, incontinence of urine has assumed an epidemic form in certain depots without exciting the suspicion of the medical officer in charge.

The following procedure is suggested as likely to lead to a diminution of these cases.

(*a*) Immediate admission to hospital of all persistent bed-wetters.

(*b*) Medical examination, with the cystoscope if necessary.

(*c*) If a permanent medical disability is found, discharge on A.F. B204.

(*d*) If the recruit refuses examination, or minor operation, returned to C.O. to be disciplined, trained, or discharged by him as not likely to become an efficient soldier.

(*e*) If no medical disability found, also sent to C.O. to be disciplined, trained, or discharged.

The point of the above scheme is that only men with a permanent medical disability should be discharged on medical grounds.

(11)

The present method of estimating the degree of "genu valgum" is very faulty, as it is largely under the man's own control. When he wishes to be enlisted he presses his knees outwards as hard as he can, and by this means it is possible to disguise knock-knee to the extent of two inches or more. When he is tired of the Service he stands with his heels apart and presses his knees inwards; the result being that a man may be enlisted having 1½ in. separation of his heels, and a week or two later discharged with six or eight inches of separation. Such cases have actually occurred, and are in no way exaggerated.

A method which is coming into use at the present time, with very good results, is to make the man sit on a chair and tell him to extend his legs fully at right angles to his body with his knees touching. The distance between the internal malleoli should be measured; more than two inches separation causing rejection.

(12)

A considerable number of discharges on A.F. B204 are classified as epilepsy. Medical officers are apt to be easily satisfied as to the genuineness of a fit, with the result that a large proportion of those discharged are malingerers. This shamming of fits is a most catching complaint, and when a recruit is able to obtain his discharge by this means, others in the same depot will follow his example. These malingerers will

obviously not make efficient soldiers, but they should be discharged on disciplinary and not medical grounds.

(13)

At first sight it is not easy to anticipate any difficulty in carrying out the regulations regarding physical standards. The regulations governing the measurement of the chest are apparently quite clear, but unfortunately the accurate measurement of the chest is not so simple. If the recruit raises his shoulders when having his maximum measurement taken, that is, in deep inspiration, he will fall short of his maximum by one quarter to one inch. The way to get the full chest expansion is for the recruit to depress his shoulders as he inhales.

Owing to the fact that the expansion of the chest is so much under the recruit's own control, he may use his knowledge of this as a means of trying to obtain his discharge after arrival at the depot; and on re-measurement by the depot medical officer he may be found to be half an inch or more under standard chest. It is obvious, therefore, that no man should be discharged as under chest measurement who is up to weight and otherwise fit.

Weight should present no difficulty. The minimum weight for the infantry recruit is 112 pounds. This is a definite minimum, and should not be departed from by the enlisting medical officer. This does not mean, however, that a recruit should be discharged who is found later to have fallen a few pounds below this minimum, as it will most probably be due to the change in his environment, and be of a temporary nature.

(14)

Whilst ordinary professional knowledge must be the deciding factor in the acceptance or rejection of recruits there are certain minor points which need to be kept in mind by the recruiting medical officer.

Abdominal scars which show signs of having failed to heal by first intention must be regarded with suspicion. The principal reason for this being that if a man complains afterwards of pain in the scar, it is difficult to disprove his statement.

It is very necessary to ask a recruit on enlistment whether he has had any pain in the scar and to enter his reply in his A.F. B178. This makes it a little more difficult for him to complain of pain afterwards. It is well to remember that the entering of minor disabilities in the A.F. B178 shows a re-examining medical officer that the condition has been observed and considered by the enlisting medical officer when he accepted the recruit, also such entries are very helpful when claims for pensions are being considered.

A moderate degree of " hallux valgus " in an otherwise normal foot is no bar to acceptance, but if complicated with " hallux rigidus," bunions or corns, the man should be rejected.

Sufficient attention is not always paid to the entering of identification

marks. Cases of impersonation are by no means infrequent, both at the primary medical examination and when a recruit is referred for examination to a specialist. Some of the apparently flagrant cases of neglect by examining medical officers have been traced to impersonation, which could not have occurred if sufficiently accurate identification marks had been entered on A.F. B178.

Conclusions.

A close study of medical recruiting conditions forces the conclusion that there is a much greater amount of malingering in the Army to-day than has been the case before, and further, that medical officers are more prone to take a recruit at his own valuation than they were in pre-war days.

As some slight proof of this somewhat sweeping slander of the present day recruit, and to a lesser extent of the medical officers in charge of troops, one example out of very many may be given.

Out of a number of recruits proposed for discharge by medical officers for incontinence of urine, and who were sent to a special hospital for investigation, over eighty per cent were returned to duty and reported as having no appreciable disease. These recruits were mostly wetting their beds to obtain their discharge, and the medical officers had overlooked such a possibility.

The responsibility for the increased number of recruits and soldiers who are discharged from the Service on medical grounds, rests, in our opinion, with the medical officers.

The reason for this deterioration in medical work is probably the shortage of junior medical officers, resulting in their being rushed from one job to another, and so still further reducing their opportunities of being trained in the work; and the extensive employment of untrained civilians.

It is essential that all medical officers connected in any way with recruiting, including specialists, should have recent training in this work.

The medical examination of recruits is a most difficult task, requiring experience and sound judgment, and the sooner the idea is dissipated that a medical officer without special training is capable of examining recruits for admission into or discharge from the Army, the better it will be not only for the reputation of the Service, but also for the finance of the State.

It should never be forgotten that the discharge of every recruit on medical grounds reflects on the skill and judgment of the medical officer who passed him fit on enlistment.

A recruit's discharge on A.F. B204 should only be resorted to when it is certain that the recruit has a medical disability rendering him unfit, and shall not take place, as too often happens, merely because the recruit is tired of the Service.

OBSERVATIONS ON BILHARZIOSIS IN IRAQ.

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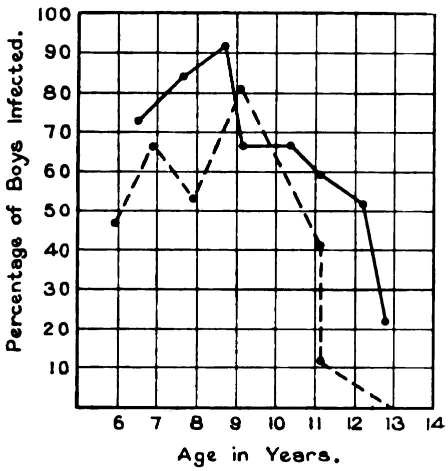
(*Continued from p.* 10.)

Bilharzia in an urban district of Iraq—namely the town of Basrah.

Basrah stands on the right bank of the Shatt-el-Arab, the river which is formed by the confluence of the Euphrates and Tigris. The effect of the tide of the Persian Gulf can be felt for 100 miles above the mouth of this river, so that Basrah standing only sixty miles from the Gulf is well within the range of the tide. Basrah is the port of Iraq and most of the inhabitants depend for their existence on various commercial activities. There is considerable pilgrim traffic through it from Persia, India and other Mohammedan countries and there is much coming and going of merchandise between it and Persia and Arabia, both by land and by way of the ports on the Persian Gulf. It is thus easily understood that people becoming infected with bilharzia in Basrah are liable to spread the infection over a wide area. The town of Basrah has a population of 50,000 distributed mainly at Ashar on the bank of the river (20,000) and at Basrah City one and half miles south of the river bank (30,000). Between, and surrounding these densely populated areas, are many gardens containing date palms, other varieties of fruit trees and numerous vegetable plots. These gardens are watered by innumerable small water channels taking off from three main canals, each of which, separated from its neighbour by a distance of half a mile, pursues a course towards the desert in a direction at right angles to the river. Besides carrying water for irrigation purposes these three main creeks are the source of water supply of the bulk of the population, and the constant scene of the washing of their household utensils and clothes, while in the hot weather they present the most attractive bathing place for a throng of children. I was posted to the Civil Hospital, Basrah, in 1920, and took up the investigation into the incidence of bilharzia among the schoolboys there. The diagnosis in all cases was based on microscopical examination of a freshly passed specimen of urine and a negative diagnosis was never made unless a centrifuged specimen showed no ova. It is useless to accept the statement of the boys, as may be realized by the fact that amongst the boys of a class of twenty-two, sixteen of whom were infected, six of those were unaware of their infection although their urine contained ova and blood-cells. The results of the investigation are shown in the following tables and graph:—

SESSION 1920-21.

Class	Total number of children examined	Number of children found to be infected	Percentage infected
Government School—			
Infants	34	21	62
1st Elementary A	31	20	65
1st ,, B	43	33	77
2nd ,,	40	31	78
1st Primary	31	18	58
2nd ,,	14	8	57
3rd ,,	6	3	50
4th ,,	7	3	43
1st Secondary	16	3	19
Total	222	140	63
American School	65	31	48
Jewish School	50	8	16



Graph showing age incidence amongst boys of Government School.

SESSION 1921-22.

Class	Total number of children examined	Number of children found to be infected	Percentage infected
Government School—			
Infants	23	9	39
1st Elementary	28	22	58
2nd ,,	27	13	38
1st Primary	22	16	
2nd ,,	27	10	37
3rd ,,	14	2	14
4th ,,	7	0	0
Total	158	72	47
American School—			
Primary	68	30	44
Middle School	43	19	44
High School	11	4	36
Total	122	53	43
Jewish School—			
Elementary	6	1	17
Primary	88	26	30
Total	94	27	29

Thus out of a total of 711 children examined 331 or forty-seven per cent were infected with *S. hæmatobium*. The statistics in the Government school show an improvement in the second year owing to the fact that some of the children, although not included in the first year's statistics, received treatment during that year. It was thought that Christian and Jewish children showed a greater resistance to the disease than Mohammedan children and this conception seemed to be borne out by an analysis of the examinations of the pupils of the American School, which is a mixed one. The analysis of the results in that school for 1922 showed that: Of Mohammedan children 57 per cent were infected; of Christian children 30 per cent were infected; of Jewish children 27 per cent were infected. This difference in incidence among the children of different religious persuasions can be explained, I think, not by any difference in resistance but by a difference in habits, for the Christian and Jewish children bathe in the creeks much less frequently than the others and consequently are less exposed to infection. Many Mohammedan families too still hold to the belief that water stored or treated in any way loses its "virtue" and therefore although a wholesome supply for household purposes may be available they persist in using what they describe as "living" water direct from the creek. The protection afforded by footgear, which is nearly always worn by Jews, also helps to reduce their incidence.

The incidence of the disease amongst boys seems to increase till about the age of 9 and then it decreases. The infection in Basrah although widespread is not nearly so severe as in Diwaniyeh, and the course of the incidence curve is explained by a tendency towards spontaneous cure rather than by the disease killing off the weaker of its victims. This contention is further substantiated by the fact that the urine of many boys who gave a definite history of hæmaturia failed to show ova after careful and repeated examination.

The effect of the disease on the physical development of the children is obvious, and one has little difficulty in picking out from a class those infected. The face is pale, thin and pinched and they wear a tired expression. They exhibit a nervous restlessness. To determine the effect on the mental development of the children, I asked the principal of the American School to classify the boys of his school as regards their intelligence and progress and applied his classification to the boys I found to be infected. The result was :—

Intelligence of Boys infected.

Class		Below average	Average	Above average
Primary	..	9 (30 per cent)	11 (37 per cent)	10 (33 per cent)
Middle School	..	4 (21 ,,)	11 (58 ,,)	4 (21 ,,)
High School	..	0 (0 ,,)	3 (75 ,,)	1 (25 ,,)
Total	..	13	25	15
Percentage	..	24·5	47·2	28·3

Intelligence of Boys not infected.

Class		Below average	Average	Above average
Primary	..	5 (13 per cent)	16 (41 per cent)	18 (46 per cent)
Middle	..	3 (12 ,,)	16 (67 ,,)	5 (21 ,,)
High ..	..	3 (33 ,,)	1 (11 ,,)	5 (56 ,,)
Total	..	11	33	28
Percentage	..	15·3	45·7	39

Although these figures suggest that the disease does not materially affect the boys' educational progress, the masters insist that they cannot get full value out of the infected children and one must remember that in Iraq only those children above average intelligence are sent for education.

Amongst the adult population of Basrah the disease is not often met with, yet of a batch of thirty prisoners from the civil jail 33 per cent were infected. I have been unable to obtain sufficient results on which to base a definite estimate of the incidence of bilharzia among girls and adult women. I should think, however, that the incidence is considerably lower than in the case of males.

It is interesting to compare these figures with those available from Egypt. Kautsky [25] found that seventy-nine per cent out of 124 boys in a school near Cairo were infected. He does not indicate the age of the boys and I gather that the school is situated outside of Cairo and therefore more strictly comparable to a rural district in Iraq. Dr. Elgood [26] working among women and children in Egypt found that: 27·5 per cent of the girls in a middle class school were infected; 20·5 per cent of the girls in a better class school were infected; 3·2 per cent of women were infected.

More recent statistics quoted by Leiper [27] put down the incidence among men in Egypt as varying between forty-four and seventy per cent in different localities and at El Marg he found forty-nine out of fifty-four boys infected.

The source of infection in Basrah is not difficult to find. The distal ends of the main creeks reach just beyond the limit of the gardens and formerly formed loops which allowed the water to circulate from one to another. The banks of these loops have for several years been uncared for and in many places have collapsed, bringing about the formation of large stagnant pools which are only disturbed by exceptionally high tides. In these molluscs breed freely. In the same way many of the smaller channels near the desert have fallen out of use and have become overgrown with weeds. On the course of the main creeks I have never been able to find molluscs and attribute their absence to the continuous movement of the water there resulting from the action of the tide and the coming and going of "bellams" or local sailing craft. It may also be stated that a good number of domestic ducks inhabit these creeks. All the same it is in

these main creeks that infection most frequently takes place and this can be accounted for by the countless cercariæ carried down in the water from the terminal reaches to the canals each time the tide recedes. The concentration of cercariæ in the large volume of water in these main creeks is low and would therefore be unlikely to give rise to a heavy type of infection. Clinical experience in Basrah bears out the fact that the type of infection prevalent is of a very mild character. Inquiry elicited the fact that school children complain most of their symptoms in autumn, that is four months after the season at which they most frequently bathe in the creeks.

As has been said, the symptoms presented in cases met with in Basrah are mild. The rash and itching produced by the passage of the cercariæ through the skin is rarely complained of. The population is so much accustomed to the bites of fleas, "sandflies," and mosquitoes that all skin irritations are liable to be attributed to such causes. Symptoms may be latent and the patient quite unaware of his infection. The early symptoms are malaise and a slight burning sensation in the urethra during and especially towards the end of micturition. Then a few drops of blood appear accompanying the last few drops of urine. In six of the twenty-two boys in the first primary class in 1922, i.e., the class showing the highest percentage of infections, visible blood was present mixed with the urine as it was passed. It can be readily understood that anæmia frequently results. The grosser complications mentioned as being frequent in the rural districts where a heavy type of infection predominates are rarely met with in Basrah residents. Amongst a large number of school boys treated the only genito-urinary complications I noted were one case of acute epididymitis, two cases of persistent urethral discharge showing ova, but nothing to suggest a gonococcal infection, and two cases of urethral calculi required meatotomy for their removal. The effect of the disease on the child's general physique has already been referred to, and I agree with Christopherson, who attributes this to a chronic toxæmia, which may result from bilharzia infection unaccompanied by superadded pyogenic infection. In the mild cases met with in Basrah rectal symptoms are, but only occasionally, met with. None of the school boys complained of rectal discharge; but such discharge was sometimes met with in cases coming to the civil hospital from outside the town, No cases of rectal papillomata were noted in Basrah, but the recent work of Sanderson and Mills [28] in Baghdad has shown that such papillomata do occur as a result of a pure *S. hæmatobium* infection. No cases were noted which would suggest that either ova or worms had invaded the general systemic circulation.

The diagnosis is easily established by examination of freshly passed urine under a low-power microscope. Fairley has introduced a complement fixation test to aid the diagnosis, but this is of much more value in cases due to *S. mansoni*, where the female worm, as has been noted, lays a much smaller number of ova. Eosinophilia is an almost

constant feature of the disease. I have never met with ova showing a laterel spine in Iraq ; so far as my experience goes, bilharzia in that country is always due to infection with *S. hæmatobium.*

In Basrah the problem of antibilharzia measures is a complicated one. The demands both of the population and of the gardens for a constant and ample supply of water from the main creeks will remain, and consequently any comprehensive scheme to carry out the drying process cannot be adopted. As funds become available, much good may be done by the regular cleaning out and repairing of the terminal reaches of the creeks and smaller channels, so that their water becomes subject to constant change and movement under the influence of the tide. Antimalaria measures in the shape of oiling the surface of collections of standing water are at the same time antibilharzia measures, for cercariæ can no more live under a film of oil than can mosquito larvæ. The elaboration of the existing stand-pipe water supply from the main river and the building of swimming baths, the water in which could be rendered non-infective by chemical treatment (cresol 1 in 10,000), are measures which will go a long way to reduce the incidence of the disease ; but such schemes call for the expenditure of large sums of money which are not at present available. In a town like Basrah, where the whole population is within easy reach of a hospital, where the occupation of the majority of the residents does not necessitate their exposing themselves to skin infection, and where even if they do come in such contact with infected water, the risk of a heavy infection is small on account of the low concentration of cercariæ in the water; in such a town the prospect of curative treatment being of real value is good. It must, however, be accompanied by an educational campaign especially in the schools.

The success of the modern treatment of bilharzia by intravenous injections of tartar emetic [29], [30], [31], as suggested by Christopherson has been proved over and over again in Egypt, but as that writer points out the dosage has not been thoroughly established. A note on the results of treatment I carried out on Basrah school boys may be valuable from the point of view of dosage, efficacy and practicability.

The administration of a drug like potassium antimony tartrate is not to be undertaken light-heartedly. Apart from the attendant risks and discomfort, the actual administration, in the case of restless children with small veins, is an operation requiring much care and considerable skill which can only be acquired by practice. The children are never keen on needle punctures and the parents, although anxious to have their children cured, fail to see the necessity of continuing treatment after the obvious symptoms disappear as they do as the result of a few injections. Consequently the course of many children was frequently interrupted while that of others was never completed. A number of results from courses carried out in 1920-21 is appended.

Name	Severity of infection × being an average Basrah infection	Age	All living ova disappeared after	All ova both living and dead disappeared after	Total amount given	Duration of treatment	Number of injections	Ova in urine examined five weeks later	Ova in urine examined nine months later
1920-21									
Yusuf Eliahow	× ×	8	2¼ gr.	3¾ gr.	8 gr.	4 weeks	12	*Nil*	*Nil*
Abdul	×	8	2½ ,,	2½ ,,	7¾ ,,	4 ,,	13	,,	Yes
Abdul Aziz Mukhlaf ..	×	9	2¾ ,,	2¾ ,,	9¼ ,,	3 ,,	15	,,	*Nil*
Abid Abdullah	× ×	10	5¾ ,,	Still present	10¼ ,,	3 ,,	15	Ova still present	,,
Abdul Kadir Mohammed ..	×	9	2½ ,,	2½ ,,	9 ,,	3 ,,	14	*Nil*	,,
Abdul Aziz Quasim ..	×	11	3½ ,,	3½ ,,	10⅝ ,,	4 ,,	14	,,	Yes
Mohammed Hussan ..	×	10	1¾ ,,	3½ ,,	9⅜ ,,	3 ,,	13	,,	*Nil*
Abdul Wahid	×	12	3½ ,,	3½ ,,	10⅜ ,,	4 ,,	12	,,	Yes
Nori Arab	×	9	2½ ,,	3 ,,	6⅝ ,,	4 ,,	9	,,	*Nil*
Saleh Baqir	× × ×	10	4½ ,,	6½ ,,	8 ,,	4 ,,	12	,,	Yes

Name	Age	Total amount given	Duration of treatment	Number of injections	Ova in urine at end of treatment	Ova in urine seven months later
1921-22.						
Hamid Naqi ..	16	16 gr.	3 weeks	16	*Nil*	*Nil*
Mehsin Hussan ..	18	20 ,,	4 ,,	19	,,	,,
Ahmed Nauroos ..	18	20 ,,	5 ,,	20	,,	,,
Talib Rahim ..	15	15 ,,	3 ,,	15	,,	,,
Eleahow Yusif ..	11	11¼ ,,	3 ,,	13	,,	,,
Selim Khalaf ..	12	13 ,,	4 ,,	14	,,	,,
Naji Yusuf ..	11	11 ,,	3 ,,	13	,,	,,
Selim Yusuf ..	12	13 ,,	3 ,,	14	,,	,,
Matook Dawood ..	12	12½ ,,	4 ,,	14	,,	not examined
Abdul Wahab ..	13	13½ ,,	4 ,,	13	,,	*Nil*
S. Haik	19	20¼ ,,	3 ,,	14	,,	,,
E. Haik	17	18¼ ,,	3 ,,	16	,,	,,
Rahman Seleh ..	18	18 ,,	4 ,,	15	,,	,,
Naji Rahmin ..	11	12 ,,	2 ,,	12	,,	,,

These results suggested that for an effective cure a total dose of one grain for each year of the child's age was necessary. The condition reappeared in 33⅓ per cent of the cases so dosed within nine months, but, as a very hot summer had intervened and as all the boys admitted to having bathed frequently in the creeks, these were probably cases of re-infection. Of boys who discontinued attendance for treatment after they had received an amount of tartar emetic equal to more than 0·5 grain but less than 0·75 grain for each year of their age all except one were still passing ova six months later. Next session I therefore chose for treatment older boys and warned them against the danger of bathing in the creeks. I based their dosage on the conclusions formed the previous year, all became free from symptoms and remained free at least seven months.

I used throughout one per cent solution of potassium antimony tartrate giving an initial dose of ¼ grain and doubling the dose each day until the maximum was reached. The smaller children could rarely tolerate more than ½ grain and the bigger ones one grain at each injection. The first year I gave injections on alternate days, but the second year I found it

advisable to avoid unpleasant symptoms by giving smaller doses without a day intervening between the injections. These unpleasant symptoms consist of retching, vomiting, and a most distressing feeling of tightness in the chest, but they rarely appear with the initial ¼ grain dose.

The dose with which they will appear varies so much with the individual that the amount given should be increased ⅛ grain each time until the maximum tolerated is discovered. Although these side effects are distressing in no case did they reach the stage of causing the operator genuine alarm, nor did collapse, muscular pain or jaundice follow the treatment.

In the case of Basrah, then, complete preventive measures are not practicable, but curative treatment can be carried out with success and is of value as the majority of the population can, if they are instructed how to do so, reduce the risk of reinfection to an almost negligible point.

It is remarkable how rarely Europeans become infected with bilharzia in Iraq. I only know of one European case amongst the civil population and up till the end of 1918 only three European military cases have occurred. At the end of 1920, however, an outbreak occurred in the British Garrison at Kufa on the middle Euphrates. A most careful investigation of this outbreak was carried out and many valuable observations regarding it were recorded by the Lieutenant-Colonel A. E. Hamerton, C.M.G., D.S.O., R.A.M.C., Assistant Director of Pathology, and from his report I am able, through the courtesy of Lieutenant-Colonel J. D. Graham, D.S.O., late I.G., Iraq Health Service, to make the following extracts: When it became apparent that infection of the British troops who garrisoned Kufa during the last quarter of 1920 had taken place, all the available men of that garrison were examined (April, 1921) and of a total of 495 men examined 111 were passing numerous ova in their urine. Many of these men had by this time been transferred to Hinaidi cantonment near Baghdad, and if the intermediate host was present were likely to spread the infection. Colonel Hamerton therefore made a collection of the snails which inhabited the numerous slow-flowing and weedy channels which intersected the cantonment, and which supplied all cantonment water except a piped chlorinated supply for drinking. These he sent through the Director of Pathology at the War Office to the British Museum, where they were classified thus:—

(1) Species known to be intermediate hosts of schistosomes:—

(*a*) *Isedora* (vel *Bullinus*) *contorta*, common in weedy channels and ponds.

(*b*) *Planorbis*, species doubtful, rare and not likely to be a danger.

(2) Species not known to be hosts of schistosomes.

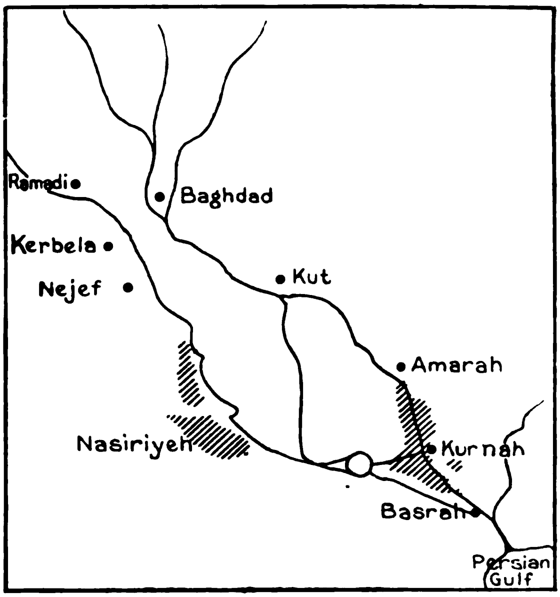
(*a*) *Limnæa persica*, very common.

(*b*) *Fruticola obstructa*, common.

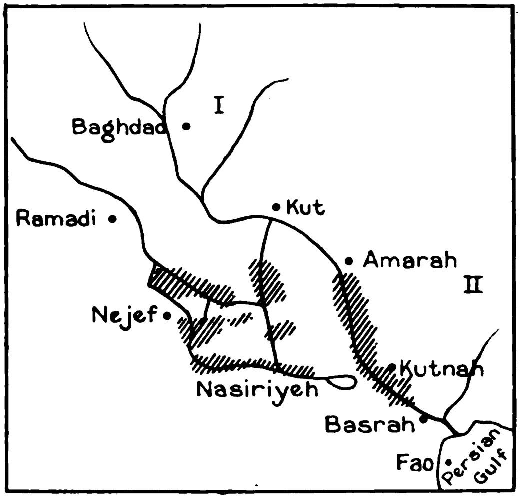
(*c*) *Malanopsia nodosa*, uncommon.

(*d*) *Ena petracus*, uncommon.

Of 250 snails dissected none were infected with cercariæ of *S. hæma-*



Map from Boulenger's report. Shaded areas show the areas in which the disease was known to prevail in 1918.



Map showing areas from which I have seen patients suffering from bilharzia and other areas from which reports of cases have been published.
I. Sanderson and Mills. II. Harrison.

tobium. In two snails, however, cercariæ of an undetermined species were found. As the intermediate hosts were found to be present, Colonel Hamerton carried out various larvicidal tests with a view to finding out how best to break the life cycle. He found:—

Bullinus thrived in a glass aquarium containing cresol solution 1 in 1,000,000.

Ova of S. hæmatobium.—In similar solution hatch quickly but soon appear paralysed and motionless.

Cercariæ (undetermined):

In cresol dilution	1—10,000	were killed in	3	minutes.
,, ,, ,,	1—100,000	,, ,, ,,	10	,,
,, ,, ,,	1—200,000	,, ,, ,,	12	,,
,, ,, ,,	1—500,000	,, ,, ,,	15	,,
,, ,, ,,	1—1,000,000	,, ,, ,,	4	hours.

It was then arranged that cresol to make a dilution of 1 in 1,000,000 should be delivered into the water entering the channels (mosquito larvæ cannot live in this more than forty-eight hours) with a view to destroying larvæ, but after several months' trial mosquito larvæ and other small pond life were still as numerous as ever in the channels. On investigation it was found that the cresol formed with the soil an inert compound—aluminate of phenol. "This," as Colonel Hamerton says, "is another proof of the limitations of laboratory experiments." Therefore, it was recommended that all the channels and ponds should be well cleared out and the rate of flow of the water increased, and that once every three months the water should be entirely cut off for a period of fourteen days. These measures produced an undoubted reduction in the snail population.

Summary.

(1) Bilharziosis is endemic in Iraq.

(2) It is widespread throughout the country and is not confined to the areas unaffected by the tide of the Persian Gulf.

(3) In Iraq it is always due to infection by *S. hæmatobium.*

(4) Its effect on the population both rural and urban is so marked that the disease must be considered an important factor in the economic development of the country.

(5) It is liable to be spread to other countries.

(6) Antibilharzia measures hold out reasonable prospect of success and should be put into operation.

(7) For the success of such measures close co-operation is required between the departments of health, irrigation and education.

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A FEW SUBJECTS FOR CONSIDERATION AFFECTING THE CORPS.

By Major D. F. MACKENZIE, D.S.O.
Royal Army Medical Corps.

The importance of combining administrative work with professional work, advocated by Major Ritchie, in the April number of the *Journal of the Royal Army Medical Corps* cannot be over-estimated.

Who has not met the keen professional medical officer who is inclined to ignore administrative questions, and thereby cause endless worry to those responsible for rendering accurate returns and keeping the necessary statistics.

Their point of view is that they are "Doctors" only and nothing else, which is a wrong standpoint.

There is no reason whatever why sound professional knowledge should not be linked with sound administrative capability, and junior officers especially should realize this and equip themselves accordingly. At most stations the training of medical officers is greatly handicapped by the fact that the strength is usually barely sufficient to carry out routine duties and allow for sickness, leave, camps, etc., with the result that officers cannot be posted to the various offices in a hospital and command for instruction.

Junior officers should go out of their way to become acquainted with the work of the various departments of a military hospital; a keen officer will soon find time for this if he has the inclination, and will not regret it during the rest of his service.

At the same time opportunities should be taken, and sought for, of attending courts martial for instruction.

Officers of our Corps may at any time find themselves isolated in some out-station abroad and must be prepared to meet all kinds of emergencies; for this reason surgical specialists should be instructors rather than actual operators, especially in the more common operations that the general practitioner might be called upon to perform. Every opportunity should therefore be taken of performing the more common operations under the guidance of the surgical specialist, and also of administering anæsthetics. Any of us may be so placed in our service that the advice of specialists is not available, therefore full opportunity should be taken of working under their guidance whenever the chance offers. No Royal Army Medical Corps officer can afford to work in watertight compartments; his knowledge must be general, his activities great, his initiative high, and his *esprit de corps* always at high-water mark.

The idea of "travelling instructors" put forward by Major Ritchie

appears to be very sound, and would be a big asset to the Corps if the right officers were chosen and the task was congenial to them.

Lecturing and imparting knowledge to others is an art in itself—not in the possession of everybody. A good lecture is often ruined by a bad lecturer.

Medical debating societies would doubtless be instructive, and should not be confined to purely professional subjects; these debates must always be conducted in the right spirit, and no officer must feel that he will be "sat upon" if he expresses views that may at first appear "out of order." Frank discussion may discover some good points in an otherwise impossible proposal.

II.

Would a medical staff course for senior captains and majors, lasting about three months, be a feasible proposition for the Corps?

Such a course, to be of practical value, should be limited to twelve or fifteen officers to allow of individual instruction.

Writing of operation orders and medical appreciation of a situation would form an important part of the instruction along with general staff duties of the Army, Navy, and Air Force.

Our officers generally have very little opportunity of studying these important subjects from the practical standpoint.

Map-reading, both theoretical and practical, must not be neglected.

Many officers of the Corps had very little instruction in this important subject prior to proceeding on active service during the late war; the knowledge they possessed was picked up by experience—but such a thing might easily lead to "regrettable incidents."

How many of our officers are cognizant of the method of reading a "gridded" map, now in use in the Service, and how many have received instruction in the method?

It is a curious fact that the "Manual of Map Reading and Field Sketching" is not amongst the books to be held by Royal Army Medical Corps officers according to K.R. paras. 1667-1670; though it will be noted that an official copy is issued to officers of the R.A.V.C. Surely the medical service has more need of such knowledge in their front-line work and in intercommunication with battalion headquarters, advanced dressing stations, ambulance headquarters, brigade headquarters, and A.D.M.S. division.

Such a medical staff course could not help but be of value in our training and selected officers could officially attend the medical manœuvres of foreign powers. Might not such a staff course replace the present examination for promotion to Lieutenant-Colonel, and be equivalent to the Senior Officers' School of the combatant branch of the Service.

III.

The question of foreign service in the Corps is becoming very acute and hits the married officer, with a family to educate, very hard indeed. It is often impossible, or extremely difficult, to obtain any information about the foreign station to which one is ordered to proceed.

Could not particulars of every foreign station be kept at the "Central Mess, Millbank," giving useful information as regards quarters, hotels, climate, schools, local allowances, etc. The mess secretary could ask some officer serving in the station to keep the records up to date. I would suggest such information be printed in the form of a handbook or pamphlet for each station and the requisite one forwarded, on application, to each officer detailed for foreign service; a small charge could be made to defray expenses, and I am sure officers would greatly appreciate the information thus obtained.[1]

IV.

A service, if it is to be efficient, must be a contented service. Are we in that happy position?

We want officers to join the Corps with the full intention of making it their life's work and not as a stopgap for ten years or more, during which time they see the world at Government expense, take all the Army can give them and then vanish into civil life with a gratuity. One cannot blame them under existing conditions, for the remedy is to make our Service so attractive and efficient that it will attract and retain the very best men the medical schools have to offer.

Personally, I am in favour of every officer joining the Corps, spending the first three years of his service living in a mess, either one of our own or a regimental mess; by this means he comes into close contact with his brother officers off duty and becomes imbued with service traditions and customs. I am quite aware that this proposal means that no officer could marry till his promotion to captain, but would this entail such tremendous hardship? I maintain it would not and that the benefit, both to the officer and the Service, would be of undoubted value.

Those of us who spent our early service living in messes have, I am sure, never regretted it, for they provide the very finest training ground for the young officer.

V.

The medical journals of the present day, including our own Journal, are tending to become more and more specialized in the subjects they deal with. Such articles are, without doubt, of absorbing interest to the specialist concerned, and in view of the lines along which medical science is progressing, the bacteriologist comes in for most attention.

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[1] This is now being considered. See CORPS NEWS SUPPLEMENT, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, January, 1925, pp. 10-11.—ED.

No doubt such articles are read, as they should be, by many who are not specialists, but I would appeal for more articles touching on the every-day work of the general practitioner.

Many officers in the course of their service must pick up many useful tips from their experience which are not to be found in textbooks. In this connexion I would ask those medical officers who have left the Corps and gone into general practice, not to forget our Journal and to forward for publication any articles they may write for the medical journals.

All medical officers should be encouraged to pass on their knowledge, and I would suggest that a few pages of our Journal each month should be given up to "Practical Hints," which can be put shortly and concisely, and should include sanitary and other subjects in addition to those of professional interest.

I think everyone will agree that the articles on "Staff Tours" and other administrative questions which appear in the Journal from time to time are very welcome. They are often the only means of instruction for many officers.

I would strongly advise officers to keep bound "extracts from the Journal," comprising articles they find of interest; it is impossible to carry about complete volumes of the Journal and these bound "extracts," if properly indexed, form a most valuable textbook for easy reference on every conceivable subject.

Lastly, could not the roster of officers on the active list, published in the Supplement, be republished more frequently, say every quarter?

Owing to frequent changes the roster soon becomes out of date, and it is a most useful means of keeping in touch with officers one has served with.

A CORRESPONDENCE CIRCLE.

By Major M. B. H. RITCHIE.
Royal Army Medical Corps.

II.

A Campaign against Sandfly Fever.

A campaign against this disease, carried out by the Royal Air Force at Malta, has been remarkably encouraging. Following on the investigations of Whittingham and Rook (*Transactions of the Royal Society of Tropical Medicine and Hygiene*, November, 1923; *British Medical Journal*, December 15, 1923), a series of recommendations advocated by them was put into execution by the R.A.F. authorities. Briefly, these measures consist of tarring walls of buildings up to a height of three feet, and tarring roads; facing and pointing walls; employment of "swatting parties" in barrack rooms every evening; removal of kits from walls and shelves, by providing lockers; beds moved into the centre of the rooms, feet towards the walls; two large overhead electric fans in each room, with a small fan in one corner to give a cross-current. Calafrana, the R.A.F. station, had a bad sandfly fever reputation in former years. This year, the number of admissions from the disease was but fourteen. No doubt a detailed account of this campaign will be published later in one of the medical journals, and in the meantime our comrades of the R.A.F. Medical Service are to be congratulated on the successful and encouraging results of their labours.

Study Opportunities at Home Stations.

An officer writing about additional degrees and qualifications gives much valuable information on this subject. In his own case he was able to arrange his duties so that they did not clash with classes. He suggests that a list of stations where additional degrees, etc., can be obtained, should be compiled. Apart from London and its out-stations, there are the University towns of the Kingdom. I have already received full information regarding the educational possibilities in Edinburgh, which, it is hoped, may be published in this Journal later on; it would be a great boon to officers serving abroad if the possibilities of other stations near medical schools could be given also. If any readers of the Journal have taken qualifications such as D.T.M. and D.P.H. recently, their practical hints on how to go about the business would be very acceptable. The new regulations for D.P.H., however, may debar many from taking it. I expect soon to have notes on the M.R.C.P. examination and on being called to the Bar; notes regarding other examinations which interest officers are wanted also.

A list of stations which have educational possibilities would be most valuable. We cannot all get to London or its vicinity, and it is likely that many other stations, not at present in demand, have facilities which have not been made known.

The Soldier-Doctor and his Training.

Strange indeed it is how much we differ in fundamentals from our comrades in other branches of the Army. They learn their jobs after they join; we learn most of ours before. The professional knowledge that we acquire outside is applied within the barrack gates, but we should get back to the outside professional world at intervals if our professional standard is to remain high, for there is not enough clinical material among young, fit troops to go round. The hygienist sees to that. Our Sandhurst and Woolwich, our Camberley, professionally speaking, are represented by the medical schools of the United Kingdom. Educationally, the regimental officer is based on the teaching institutions of the Army; we are mainly based on the teaching institutions of the medical profession.

Another point that should be remembered—when the regimental officer and the medical officer retire with, say, twenty years' service, the professional market value of the former diminishes steadily as he continues on the reserve of officers. In the case of the latter, however, if he works hard at his profession his market value has not diminished; on the contrary, it is probably as high as it was while he remained on the active list.

The R.A.M.C. and the Staff College.

Among letters received from brother officers was one which contained the following remark: "An executive medical service is a big conception. . . . It would probably involve our people going to the Staff College—a project we always felt keenly in favour of. We're brought up very much in our own ways and only by luck do we learn about other units and general organization; while they know little or nothing about ours."

I think everyone who holds progressive views is agreed that the portals of the Staff College should be thrown open to us. To the non-medical mind it may seem strange, verging upon the ridiculous; yet it is nothing but an obvious, sensible and simple method of increasing war efficiency; it is a reform that will come some day, probably in the British Army before Continental armies.

Not long ago we were an adjunct to an army; soldiers went sick, doctors were required to treat them. As spiritual welfare demanded the presence of chaplains, so bodily welfare demanded doctors. The latter were difficult to obtain, but by means of Royal Commissions and Committees, assembled at varying intervals throughout the Victorian era, the Medical Service was renovated and made sufficiently attractive to induce young medical men to enter. As conditions declined towards unattractiveness and medical men ceased to enter, another committee was assembled, better conditions were offered, and the men came forward. It is an important fact that the history of our Service is staged out in a succession of committees or commissions, the intervals between them being filled in with periods that began with attractiveness and tapered off into unattractiveness, ending with the appointment of another commission.

But this state of affairs, peculiar to a medical service, must terminate,

for the pendulum swings the other way, the boot is on the other leg. Our function has changed and there is now a big market value, a war efficiency value, attached to us. Countries will call medical science to the aid of their armies, not only because their soldiers require doctoring, but because this science is one of the "big noises" of future war. Hence will come a reaction; the young medical man will be sought out and encouraged to combine the study of medicine with that of war, so that he can apply his knowledge better. A medical man engaged in medico-legal work fits himself for the work by being called to the Bar, whereas in medico-military work he cannot at present study soldiering, for it is a closed profession as regards higher teaching.

Thus it is probable that the Staff College will be opened to the medical officer in course of time; war efficiency is the key that will unlock the gates. When this happens, let us hope that his admission will not be made easier on account of belonging to a profession different from that of other candidates. Let him receive no concession; let him gain admission in open competition with his regimental comrades, in a fair field and no favour; if he can do this, his value to the Army is indeed high.

Medical Arrangements for Tanks.

I am indebted to a distinguished officer for a subject that requires discussion, and that is the medical arrangements for Tank warfare. Development of the tank arm has gone on fairly fast. A great deal can be learnt by reading "Tank Training," vol. i. Few of us are in a position to form opinions, as we dwell in stations where tanks are not. He who happens to be *au courant* with military thought in relation to the future rôle of tanks is best qualified to discuss the subject, as one must know this before one can approach the question of medical arrangements.

Here is an instance where experience of war in Eastern theatres may be superior to that gained in France. The rapid forward rush in the later phases of the campaign in Palestine may approximate nearer to the tank conception than the operations in France. Many officers may possess sound views about the medical arrangements for tanks, and everyone will welcome an expression of these views if they care to write them.

On this subject, Broster's article on medical aspects of tanks, published in this journal a few years ago, mentioned the possibility of medical tanks. After Cambrai in 1917 it seemed to the writer that the tank would become the mobile advanced dressing station of the future, and it was to the regret of Broster and myself that we were unable to induce higher authorities to interest themselves in the scheme. The point was, why form an advanced dressing station in the cellar of a ruined house, or in a dug-out, when almost as much accommodation could be obtained in an infantry-carrying tank, mobile and proof against everything save a direct hit? However, these were the early days of tanks; if this arm is employed on the lines envisaged by Fuller in his "Revolution of War," or even as described in "Tank Training," vol. i, medical tanks will have to be brought into commission.

Clinical and other Notes.

A CASE OF ŒSOPHAGEAL STRICTURE.

By Major C. M. FINNY, F.R.C.S.,
Royal Army Medical Corps.

In medical and surgical practice there are certain dangers against which students are constantly warned. Some of these, such as the risk of a bubble of air entering a vein during an infusion, are overrated; but others are very real. The following case appears worthy of record as an example of the danger of passing an œsophageal bougie as an aid to diagnosis or treatment in the case of stricture of the œsophagus.

Sergeant H., aged 30, was admitted to hospital on November 7, 1922, from overseas, with a history of persistent epigastric pain for the past fortnight. A few days later I was asked to see him on the grounds that he was vomiting everything he swallowed. An examination of the "vomit" showed that it had never reached the stomach, and a barium meal revealed an almost complete stricture of the lower end of the œsophagus, commencing one and a half inches above the diaphragm. The œsophagus was markedly dilated above this point, and the X-ray plate showed a very fine irregular line of barium leading down through the stricture into the stomach. The apparatus was not working well, so that a satisfactory view was not obtained with the screen. Though a definite diagnosis of the cause of the stricture could not be arrived at, it was clear that the local condition was inoperable, so I performed a gastrostomy on November 13.

The patient progressed favourably for the first few days after the operation, though worried by inability to swallow his saliva and the same epigastric pain.

On November 17, however, a little blood was detected in this regurgitated fluid, and the following night he brought up about a pint of blood at 3 a.m. The bleeding recurred at 9 a.m. on the 18th, and there was a final profuse hæmorrhage that evening.

Post-mortem.—The stomach was distended with recent blood-clot. Immediately above the diaphragm was a saccular aneurysm springing from the descending aorta. The lumen of the lower end of the œsophagus was almost completely occluded by the aneurysmal sac which bulged into it. Above this, the œsophagus was dilated and filled with blood-clot. The floor of the dilatation was formed by the superior wall of the sac, which was reduced to the thinness of paper. It was at this point that the fatal perforation had occurred.

In this case, had an attempt been made, in the hope of arriving at a

more accurate diagnosis, to pass a bougie or even the œsophagoscope, the result might have been instructive to the onlookers, but could have been nothing but mortifying to the patient and surgeon.

A CASE OF HUMAN INFESTATION WITH *BELASCARIS MYSTAX.*

By Major R. F. DICKINSON,
Royal Army Medical Corps.

The following case is of interest in that infection with this parasite is very rare in man, the optimum host being one of the Felidæ.

The patient was a girl aged 3 years, the daughter of British parents of good social position stationed in Mauritius. One worm was passed in a copious putty-coloured stool. The child was in good health and has remained so ever since. The fæces contained *Belascaris mystax* eggs with fine honeycomb markings.

Treatment with santonin and pulv. scammony co. on two occasions failed to produce any more worms.

A point of interest in the case is that there was a very thin and sickly cat in the house at the time from which the child probably got infected. The cat was destroyed by the child's father before the nature of its illness could be investigated.

My thanks are due to Dr. Clark H. Yeager, Senior State Director, International Health Board, Rockefeller Foundation, who very kindly cut sections of the worm and identified the specimen for me as *Belascaris mystax*.

A CASE OF TRAUMATIC PERFORATION OF THE JEJUNUM ASSOCIATED WITH COMPOUND FRACTURE OF THE LEG, NECESSITATING AMPUTATION.

By Captain D. McKELVEY, M.C.
Royal Army Medical Corps.

Lance-Corporal H. was admitted to hospital at 11 a.m. on July 22, 1924, with the diagnosis of compound fracture of the left leg. He gave the following history :—About 7.30 a.m. that morning whilst riding a horse over a jump in the riding school of his unit the animal fell and rolled on top of him.

Condition on admission.—A moderate degree of shock was present. The temperature was 97° F., and the pulse rate 94 per minute. The blood-pressure was not much below normal. There was an extensive wound in the lower third of the left leg through which the broken ends of

the tibia and fibula were protruding. The left ankle-joint was laid open. The astragalus was fractured and dislocated, and protruded through the skin wound. There was also a fracture of the os calcis. The foot was pale and cold. No pulsation could be made out in the dorsalis pedis or posterior tibial arteries. The patient also complained of severe pain in the epigastrium. There was no history of nausea or vomiting. Both rectus muscles were intensely rigid. The breathing was thoracic in character Tenderness was generalized but was most marked just above and to the left of the umbilicus. There was no diminution in the liver dulness, and there were no external signs of bruising of the abdominal wall.

The patient was warmed with hot-water bottles and blankets and a hypodermic injection of morphia ¼ gr. and atropine 1/100 gr. given. After half-an-hour there was no improvement in the abdominal condition, and it was decided to operate at once as it was felt that a rupture of the intestine had occurred. The anæsthetic was administered by Captain C. P. Chambers, R.A.M.C. Induction was carried out by chloroform and ether, and thereafter open ether was given. The abdomen was opened by a left rectus incision. On incising the peritoneum some free fluid and a small quantity of gas escaped. A rupture about the size of a sixpenny piece was found in the jejunum twelve inches from the duodeno-jejunal junction. The long axis of the perforation ran at right angles to the long axis of the gut. The edges of the rupture were ragged and contused. The opening was closed by two layers of catgut sutures. The whole gut was then systematically examined, but no further perforations were found. The abdominal cavity was mopped dry as far as possible, a suprapubic drain inserted and the operation wound closed. Attention was then directed to the foot. After a hurried examination it was apparent that it would not be possible to save it. It was decided that immediate amputation afforded him the best hope of recovery, as it was felt that the additional shock likely to supervene if the foot were left would greatly minimize his chances. Amputation was accordingly carried out through the leg. After the operation 750 cubic centimetres of 6 per cent gum acacia in normal saline were given intravenously and rectal salines were administered four-hourly. For the first three days his condition remained critical. On the second day he vomited several times. On the morning of the third day vomiting became very troublesome and persistent. A tube was passed and the stomach washed out, and thereafter his condition steadily improved and gave no further cause for anxiety.

The case would appear to be of interest from two points of view, viz.:—

(1) *The question of diagnosis.*—The general symptoms exhibited and the condition of the pulse were no more than might have been produced by the leg lesion alone. The diagnosis of an intra-abdominal lesion was based entirely on the abdominal pain, tenderness and marked muscular rigidity which were present. These signs were considered sufficient to warrant exploratory laparotomy. Rowlands and Turner state that a certain

diagnosis in these cases is seldom possible for twelve hours or longer, but they recommend that operation should not be postponed on this account.

(2) *The mode of production of the rupture.*—As a result of experiment in animals, B. F. Curtis, of New York, came to the conclusion that such an injury is not of the nature of a true rupture, i.e., a bursting of the wall of the gut over its contents, but a contused and lacerated wound caused by the gut being crushed between the contusing body and the bony parts. From this it would appear that a rupture is more likely to be produced when the gut is empty. These conclusions were amply supported by the ragged and contused appearance of the edges of the perforation. As the accident occurred before breakfast the jejunum was to all intents practically empty.

I am indebted to Lieutenant-Colonel L. Wood, R.A.M.C., for his kind permission to publish these notes, and to Captain C. P. Chambers, R.A.M.C., for his skilful administration of the anæsthetic.

A CASE OF SYPHILITIC BASAL MENINGITIS.

By Captain V. J. BONAVIA.
Royal Army Medical Corps.

It is well recognized that the severe headaches which sometimes occur after a primary chancre is healed, and before the secondary stage has developed, may be due to some meningitic conditions, and the following case is of clinical interest as it affords evidence that definite neuro-syphilis may appear in the secondary (and even early secondary) stage of syphilis, as well as in the late tertiary stage. It also illustrates the tendency of the syphilitic virus to settle in a previously damaged tissue.

The patient, Corporal M., gives a history of having been in perfect health up to April, 1917, when he became involved in a shell explosion by which, he states, he was "knocked unconscious" and buried in the debris, from which he was eventually "dug out." He suffered from severe concussion and its after-effects, for which he was admitted to hospital. He was under treatment in various hospitals until January, 1918, when he was invalided from the Service for "shell-shock" and awarded a full pension.

He apparently made a good recovery and re-enlisted in the Army in September, 1919. He suffered from malaria and sandfly fever in Mesopotamia in 1920, and on both occasions severe headache was a prominent symptom, which did not clear up for an unusually long period. Subsequently, except for one admission to hospital for "myalgia" in June, 1923, he was in good health, until he contracted syphilis in July, 1923. The dates of the appearance of the manifestations are significant as indicating a severe and virulent infection.

July 23: Exposure to infection. August 6: Appearance of primary

sore (fourteen days' incubation); August 19: Secondary rash. On this date he reported sick and was admitted to hospital.

Condition on Admission.—Œdema of penis. Phimosis with purulent discharge. Indurated sore palpable beneath prepuce on left side. Enlarged and indurated lymphatic glands (inguinal, epitrochlear, submaxillary). Scattered papular syphilide on arms and trunk. Persistent, *very severe headache.*

August 21: Blood Wassermann + +. August 28: *Spirochæta pallidum* found on gland-puncture.

Treatment.—Energetic local measures. Intra-muscular injections of sulfarsenol and mercurial cream. The primary sore was healed by September 24, and he was discharged hospital to duty on October 10, to continue treatment as an out-patient.

On October 16 his blood gave a strongly positive Wassermann reaction.

By October 29 he had received in all 3·02 grammes of sulfarsenol and seven grains Hg. All symptoms had cleared up and he had thirty days' rest from treatment, followed by fourteen days KI. He states that during this rest *headaches* returned.

On September 7 a second course was commenced and he received, in all, 2·46 grammes of sulfarsenol and six grains Hg. The last injection was on February 1, 1924. Soon after treatment was stopped the *headache again returned.* He was admitted to hospital and transferred to the Royal Victoria Hospital, Netley, on February 18 as "? mental." I examined the patient immediately and made the following notes:—

"Temperature 101°. Pulse 64. Mentally dazed. Answers questions vaguely, and, at times, irritably. Unable to stand unsupported on account of giddiness. Very acute headache with violent pain behind the eyes, at back of neck and on top of head. Vision bad. Complains of seeing coloured figures before his eyes. Very acute trigeminal neuralgia on both sides. The pain is so severe as to cause him to cry out loudly at times. Secondary syphilitic rash on chest and back. General enlargement of lymphatic glands. Hair falling out."

Nervous System.—Stiffness of muscles at back of neck. Slight retraction of head. Kernig's sign present. Reflexes present and normal. Pupils unequal and react sluggishly to light.

Ophthalmoscopic Examination.—Marked double optic œdema. Discs swollen generally with much injection, the margins merging into hazy retina with vessels curling over edges. Venules engorged, wavy, and dipping into exudate. Occasional flame-shaped hæmorrhages near discs, especially the right.

Lungs, Heart, Abdomen.—Nothing abnormal detected. On the strength of the history and the ophthalmoscopic examination, I diagnosed basal meningitis of syphilitic origin and at once commenced anti-syphilitic treatment as follows:—

Pil. hydrarg. gr. 2 b.d., KI gr. xv. t.d.s., increased later to gr. xx t.d.s. Morphia gr. ¼ nocte.

The following extract from Army Form I 1237 will show the further treatment and progress of this case :—

February 22, 1924. Blood : Positive sigma in highest dilution ++++. February 25 : 0·3 gramme N.A.B. (914) intravenously. This, as expected, aggravated the patient's condition somewhat and he had a very bad night with acute pains in the head. Morphia gr. ¼. February 26 : Feeling better. February 27 : Fairly good night. Pains in head distinctly less. March 2 : Ophthalmoscopic examination showed condition of optic discs worse. Lumbar puncture performed. Thirty-three cubic centimetres cerebrospinal fluid withdrawn. Pressure markedly high Fluid slightly turbid. 0·4 gramme N.A.B. (914) intravenously. March 3 : Much better night. X-ray examination showed no abnormality in sinuses or skull. March 4 : Laboratory report on cerebrospinal fluid withdrawn on the 2nd inst. Cell count : 218 per cubic millimetre. Lymphocytes predominating. Globulin increased. March 9 : Sigma reaction cerebrospinal fluid positive in highest dilution ++++. March 10: 0·6 gramme N.A.B. (914) intravenously. No reaction. Patient sleeping much better. March 17 : 0·6 gramme N.A.B. (914) intravenously. Patient states that his headaches have now disappeared. March 24 : 0·8 gramme N.A.B. (914) intravenously. Patient is now convalescent. His mind is quite clear and all the physical signs of meningitis have completely disappeared.

Ophthalmoscopic Examination. — Optic œdema practically gone. Physiological cup now visible. Margin of discs clearly defined except for slight blurring at nasal sides. Veins normal.

April 4 : Patient has been up and walking about during the last few days. Symptoms of salivation have appeared, due to Hg, which has been taken regularly since admission, in the form of Pil. hydrarg., 2 grains twice daily. Slight diarrhœa with trace of blood in stool. Hg and KI stopped. Rest in bed. 14th : Sigma reaction (blood) negative. Patient up and walking about. April 23 : Complains of slight dizziness and headache. April 25 : Provocative dose 0·3 gramme N.A.B. (914) intravenously. April 26 : Cerebro-spinal fluid examined. Laboratory report states : "Cells eighteen per cubic millimetre. Globulin normal. Sigma ++." (Compare with reports on March 4, 1924, and March 9, 1924).

In the view of the tendency to a recurrence of headaches in the intervals of active treatment, and having regard to the laboratory findings at this examination of the cerebrospinal fluid, it was decided to give another course of large doses of N.A.B. (914) intravenously, together with a second course of Hg and KI by the mouth, as follows :—

May 1 : 0·6 gramme N.A.B. (914) headache disappears. May 8 : 0·8 gramme, N.A.B. (914). May 15 : 0·8 gramme N.A.B. (914). May 23 : 0·8 gramme, N.A.B. (914).

The patient's condition was now extremely satisfactory and only good results appear to have attended the combined administration of large doses o N.A.B. (914) with mercury and potassium iodide.

June 5: Report on cerebrospinal fluid:· Cell count less than nine per cubic millimetre. Globulin not increased. Sigma reaction faintly positive. Ophthalmoscopic examination showed no sign of incipient atrophy. The optic discs and fundi were normal. Vision acuity was unimpaired. Though the disease cannot yet be considered as cured, it is under complete control, and it is hoped that cure will eventually result under continued routine anti-syphilitic treatment. It would appear that, as the result of the concussion sustained in 1917, this patient's cerebral tissues presented an area of diminished resistance to infection, which accounted for the severe and persistent headaches that formed a prominent sympton during the attacks of malaria and sandfly fever. Similarly, it is reasonable to assume that this previous injury was a definite factor in causing meningitis in a case already receiving the recognized anti-syphilitic treatment. The condition of the optic discs, a cell count (cerebrospinal fluid) of 218 per cubic millimetre and a strong positive sigma reaction (blood and cerebrospinal fluid) were considered as indications for energetic treatment.

Fortunately the patient stood this treatment very well and showed no sign of toxæmia, if one excepts the salivation due to mercury, which was produced intentionally.

The patient did not show the slighest trace of jaundice or other sign of intolerance at any time.

Signs of increased pressure followed the first injection of 914. The second injection was preceded by lumbar puncture and no reaction followed.

From the day of admission to hospital he was brought, as rapidly as possible, under the influence of mercury and iodides.

He improved so much that no reaction followed the third injection of 914, and from this onward the case progressed satisfactorily without the slighest difficulty.

I am greatly indebted to Major W. E. Marshall, M.C., for his valuable advice and assistance in the care and treatment of this patient and to Colonel W. R. Blackwell, C.M.G., R.A.M.C., Officer Commanding, Royal Victoria Hospital, Netley, for kind permission to publish the case.

NOTES ON THE CHLORINATION OF MILK.

By E. P. MINETT, M.D., D.P.H., D.T.M. & H.
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I HAVE for some time past experimented with chlorine in varions forms in order to find if possible an efficient and easily applied method of rendering milk safe for domestic consumption, without having to boil it as is usual in the Tropics. During the last eighteen months I have tried various samples of milk but with very unsatisfactory results. Mansell [1] describes a process for the chlorination of milk, and my results agree with

his, in part only, in that chlorine does not appear to kill out the coliform organisms. Also chlorination certainly does keep milk sweet and free from clotting for a reasonable time. At the request of the Dairy Farm in Hong Kong I carried out a special set of tests recently in order to see if milk could be chlorinated before sale.

Six samples of milk were examined on successive days with the results as tabulated.

On receipt the samples contained lactose fermenters or coliform organisms varying from 1,000 per cubic centimetre up to 1,000,000 per cubic centimetre. Further investigations of these organisms on the lines of MacConkey's group system showed that in five specimens they corresponded to the tests for *Bacillus coli communis*, *B. lactis aerogenes*, *B. acidi lactici*. In one specimen *B. friedländer* was isolated in addition.

Chlorine was used in the form of a four per cent solution of chlorinated lime in sterile tap water. The chlorinated lime on analysis give 29·9 per cent available chlorine.

More than 100,000 lactose fermenters per cubic centimetre is a fair average of the samples of milk examined before chlorination. Chlorine solution was added as shown in the table below. All samples were tested for free chlorine half an hour later by means of the starch and potassium iodide test, and all showed the presence of free chlorine. One cubic centimetre samples taken from all after exposure to the chlorine for half an hour each, showed lactose fermenters as present in one cubic centimetre of a 1 : 10 dilution with sterile water. The same result was obtained after exposure for one hour. The chlorinated milk was kept in covered bottles at a temperature of 15° C. to 20° C. and again examined with the following results :—

Eighteen hours after Chlorination.

Sample No.	Amount of 4 per cent chlorinated lime solution added to 100 c.c. of milk	Acidity to litmus	Free chlorine detected	Smell acid or otherwise	Clotting	Lactose fermenters present or absent 0·1 c.c.
1	0·5 c.c.	±	–	–	+	+
2	1·0 „	±	–	–	+	+
3	1·5 „	±	–	–	–	+
4	2·0 „	+	±	–	–	+
5	2·5 „	+	+	–	–	+
6	3·0 „	+	++	–	–	+
	After thirty-six hours' Exposure.					
1	0·5 „	+	–	Sour	+	+
2	1·0 „	+	–	„	+	+
3	1·5 „	+	–	–	–	+
4	2·0 „	+	–	–	–	+
5	2·5 „	+	–	–	–	+

All samples were again examined after an exposure of forty-two hours with similar results to those shown after thirty-six hours' exposure.

From these experiments I came to the conclusion that chlorine as a milk purifier was of no value, even if allowable under the Food and Drugs Act, as although it certainly prevented the milk from going sour

and clotting for a considerable time, still it did not kill off the organisms as it does in water.

This I suggest is due to the chlorine being unable to penetrate the fat globules and possibly the other albuminous constituents of the milk, so that organisms are not killed off, when the chlorine is first introduced, later on they grow freely again when introduced into the MacConkey lactose bile salt broth. It would seem that chlorine to be efficient must be able to get at the organisms quickly and in a free state; any fatty or albuminous substance present seems to eat up the free chlorine and so prevent its action on the organisms themselves. In fact milk appears to prevent efficient sterilization by reasonably small quantities of chlorine in much the same way as highly polluted and cloudy water will do unless the water is previously clarified.

REFERENCE.

[1] *Journal of the Royal Army Medical Corps*, No. 5, Vol. xxxix, November, 1922.

Reports.

TRAINING COLONIES IN THE TREATMENT OF TUBERCULOSIS.

Summary of the Transactions of the Tenth Annual Conference of the National Association for the Prevention of Tuberculosis.

By Colonel J. C. KENNEDY, C.B.E., K.H.P.
Royal Army Medical Corps.
One of the delegates.

Dr. Kay Menzies opened the discussion on the part played by training colonies in the treatment of tuberculosis, and began by answering the question "What is a colony?" He showed that the colony was originally evolved as a supplement to the sanatorium, in order that while under medical supervision the patient might be gradually rendered fit to return to his civil employment, or, if that employment were unsuitable, trained to take up a more suitable pursuit. He proceeded to discuss the advantages and disadvantages of two forms of colonies—the vocational training colony and the village settlement—examples of both of which are now in existence. The village settlements such as Papworth Hall and Preston Hall were founded for the benefit of the tuberculous ex-service man and his family, and while serving this purpose, in the case of the pensioned man, can hardly be considered as practical propositions by local authorities, by reason of capital expenditure, and the heavy annual cost of maintenance.

The vocational training colonies, however, he considers to be in a

different category in so far as they amplify the need for a continuance of extended sanatorium treatment. He pleaded for a recognition of this fundamental object of such a colony and pointed out in what ways many of them had failed in their purpose.

Lack of success in these training colonies could be attributed to :—

(*a*) Too great ambition in initial outlay—such as the purchase of large country houses, etc.

(*b*) Failure to select suitable men. It is of the greatest importance to select those who are physically and temperamentally suitable for colony life.

(*c*) Failure to recognize that training must be secondary to treatment.

(*d*) Absence of an organization to provide a suitable post for every colonist before leaving the colony. The colony must be closely linked up with a care organization.

He then referred to the Burrow Hill colony, and closed with a summary of fundamental principles which should be kept in view in making provision for dealing with tuberculosis.

Dr. A. Sandison (A.D.M.S., Ministry of Pensions) followed with a statement as to the relation of the Ministry of Pensions with the tuberculous ex-service man, and pointed out the favoured position of the ex-service man in comparison with the non-pensioned tuberculous patient of the same class.

It was evident that any discussion on the future of training colonies must take this absence of financial aid for the non-pensioned into consideration. Furthermore, the difficulty of organizing a complete change of occupation for disabled men in middle life is almost insuperable, involving the co-operation of Government departments, local authorities, care committees, employers and employees, and if these difficulties are overcome one has still to reckon with the personal factor of the man himself, and of his employers, together with the difficulties of the labour market.

In conclusion, he emphasized the absolute necessity of providing for the dependents of the man while he is in the colony.

In the course of further discussion, the unfairness of saddling industry with the unremunerative consumptive labourer was emphasized, and a great point was made of the preventive method of dealing with the spread of infection by isolation of infective cases, and Lancashire and Cheshire were instanced as cases in point.

The Secretary of the Tuberculous Ex-service Men's Society, Leeds, was very emphatic in his statement that the settlement was the real solution of the problem, but he agreed that it was too expensive. He was opposed to the combination of treatment and training, and considered farm work to be out of the question. He referred to the unstableness, both mentally and physically, of the tuberculous person, and deprecated any excessive expenditure in training. He was strongly of opinion that local care

committees could find schemes where a great deal of capital expenditure is not required, and where medical men could co-operate with business men. He instanced Leeds, where there has been established a practical scheme which is employing from sixty to one hundred tuberculous people and is self-supporting.

The Conference passed the following resolution:—

"That this Conference resolves that what is most needed in the work of prevention of tuberculosis is better provision for after-care, including workshop schemes, and that the Council of the National Association for the Prevention of Tuberculosis be instructed to give special consideration to the matter, and to submit definite proposals to the Minister of Health."

Care Committees.

The afternoon session was devoted to discussion on the organization of care committees in farm and rural areas. The discussion was opened by Lieutenant-Colonel J. A. Ellis, Lecturer for the Association. His paper was very carefully thought out, but treated the subject more or less from an academic point of view, and was criticized as being unpracticable. The subsequent discussion was of considerable interest in that numbers of lay delegates contributed their experiences of the organization and practical uses of care committees. It was obvious that by a pooling of the methods employed by the committees in various districts, a very sound and practical line of work could be established throughout the country.

Burrow Hill Training Colony.

The visit to the Burrow Hill training colony was an interesting experience, and brought out most emphatically the difficulties associated with the scheme.

The colony was started in 1917 to meet the sudden need of the tuberculous ex-service men, and is supported by a grant from the Ministry of Health and subscriptions through the agency of the National Association. Small contributions are also forthcoming from local health committees for their respective patients. There are three pavilions containing 80 beds; 20 of these are for cases requiring sanatorium treatment, the remaining 60 are for men who are sufficiently recovered to undertake some occupational work. These latter (trainees) are all pensioners. The colony provides three courses of training which last about two years, e.g., market gardening, light farming, and rural carpentry.

The members of the Congress were shown round the estate and after lunch met in the recreation hall to hear the report of the Superintendent. A very illuminating discussion followed, and as the meeting was open to whomsoever cared to walk in, many of the patients were present, and through the agency of several of the lay members, town councillors, etc., were able to voice many grievances, supposed or real. The situation was difficult, but was ably handled by the Chairman, Sir Robert Philip.

Complaints were made that their life in the Colony did not necessarily improve their health, that the nature of the instruction did not fit them to

start on their own when they left the Colony, that starting on their own in the labour market was impossible without capital, and though the Ministry of Health made certain provision, it was inadequate, that they desired to have a say in the running and the management of the Colony, and that the food was not always what it should be, in their opinion.

This gives an indication of the feeling amongst the trainees; how much was genuine, and how much was fostered by indiscreet investigation on the part of certain of the visitors, is difficult to say. My own impression was that complaints could be traced to two causes, or perhaps three:—

(1) The feeling of uncertainty as to the future, in some cases amounting to hoplessness.

(2) The temperament of many being absolutely unsuited to the environment. To put it plainly, some of the men were of the "street corner" type, who never would put hand to regular and steady work.

(3) Separation from family.

The Superintendent's report covered the period July 10, 1922, to December 31, 1923. During that period 106 were admitted to the sanatorium and 125 as trainees; 172 were discharged. The men came from all parts, and their occupations prior to enlistment were very varied, but the large proportion are classified as labourers.

A point of interest is that of 125 trainees admitted only 43 had suffered from the disease for less than four years. This, the stage and duration of disease, must be an important factor in the success of the scheme. It is noted that 37 of the 125 trainees showed T.B. in the sputum. The after history of 87 trainees shows that 40 completed courses of training, while 38 proved unsatisfactory for training, and nine were discharged on domestic grounds. Nine of the 40 trained men took up carpentry, and seven found employment, the other 31 were trained in market gardening, and only seven of them found employment.

The cost per head, per week, is stated to be: for the sanatorium £2 6s. 10d., and for the training colony £2 12s. 6d., and the farm is self-supporting.

Sufficient has been said to indicate the difficulties, quite apart from the financial cost, inherent in this scheme. But the energy of the National Association, assisted by the Care Committees, and the co-operation of the Tuberculous Medical Officers, Local Health Committees and the Ministry of Health, should go a long way to find some means of surmounting these difficulties and ameliorating the lot of the tuberculous subject.

LABORATORY WORK IN TURKEY, 1920-1923.

By Captain H. T. BENSTED, M.C.
Royal Army Medical Corps.

When the post of D.A.D.P. was instituted in the spring of 1920, the Force in Turkey, although considerable, was very scattered and at the same time in the process of demobilization. There were still troops in Salonica as well as far inland from the Black Sea. Apart from the medical units with the South Russian Military Mission, there were four general hospitals, two stationary hospitals, one casualty clearing station, and three field ambulances—all treating sick. Each of these units had a small clinical laboratory where at least full microscopic examinations could be made, and every unit could diagnose its own cases of malaria, so that treatment could be commenced without any delay. There were four larger laboratories in the general hospitals where all the ordinary routine work was carried out. There was also a central laboratory where the more advanced serological work was performed, animal inoculations were done, and vaccines prepared in bulk for the Force. Here also chemical work and the training of officers for the smaller laboratories was carried out. The establishment was two officers, five N.C.Os. and five other ranks, plus local labour.

Towards the end of 1920 the Force had diminished and it was found possible to begin to close down some of the medical units. The central laboratory then moved into a section of No. 82 General Hospital—which was the central hospital—and, apart from the routine work of the Indian General Hospital, it was now found possible to carry out all the laboratory work with the reduced establishment of two officers (shortly after reduced to one) and two other ranks.

When, in the autumn of 1922, the Chanak crisis arose and the concentration of troops began in the Dardanelles, new medical units were organized for that area. A central hospital was established at Kilia, on the opposite side of the water to Chanak. An A.D.P. was appointed and a district laboratory was at once put up in the hospital grounds. Although this was only a field laboratory, all the routine work from the hospital was done in it, in spite of the frequently trying and difficult conditions.

Both laboratories closed down with the final evacuation of the troops from Turkey in September, 1923.

The three main causes of disability throughout the period were acute diarrhœa, malaria and venereal disease, and work in connexion with these three groups of diseases constituted the main work of the laboratory.

Dysentery and Diarrhœa.

It was not possible to concentrate all these cases in one hospital owing to the distribution of the troops, and special runners had to be employed to bring specimens to the laboratory as quickly as possible in order to ensure their freshness. Even then the results obtained were poor as compared

with the results obtained with specimens from the hospital in which the laboratory was situated. The routine method adopted was as follows: A suitable portion of the fæces was taken and emulsified in saline and part of it was inoculated directly on to MacConkey or litmus lactose media; the other part was examined microscopically. Extremely few cases of amœbic infection were seen and certainly no epidemic during the period occurred. The small number of cases diagnosed all gave histories of previous attacks in other places. Bacillary dysentery was the type and the Flexner group was responsible for the majority of the cases. In the period immediately preceding the Chanak crisis, the troops had been occupying permanent quarters; a high standard of hygiene was possible. The incidence of dysentery had gradually declined to a very small figure indeed. But as soon as the movement of troops began in the Dardanelles, bacillary dysentery commenced to occur in considerable numbers—over thirty cases in the first week. As soon as it was possible to commence laboratory work at Kilia a very high percentage of positive findings was obtained in the dysentery cases. Nearly fifty-five per cent of the cases of acute diarrhœa in Kilia proved to be Flexner Y infections; in the Constantinople area, however, only forty per cent gave this result during the same period. The method of diagnosis was to pick off suggestive colonies from the plates after fifteen to twenty hours' incubation and to test them against a high titre serum by the rapid method on a slide. In this way a diagnosis could be obtained immediately. The organism was tested against the sugars also to confirm the finding. In the period preceding the Chanak crisis, the proportion of the original Flexner V to Flexner Y was about three to two, but afterwards Flexner Y constituted about seventy per cent of all the Flexner infections. Shiga infections were not frequent, but they were always extremely severe cases. *Bacillus morgan* and *B. schmitz* were recovered from a fair number of cases of a milder dysentery; they were not so regular in their serological reactions as were the Flexner and Shiga types. Flexner Y was found in two healthy carriers eleven and nine months respectively after they had experienced any diarrhœa. In 237 successive cases of acute diarrhœa with blood and mucus: Flexner group was found 156 times; Morgan group 39 times; Schmitz group 30 times; and Shiga group 12 times.

Malaria.

The examination of blood films for malaria parasites produced the greatest amount of routine work in the laboratory. In 1920, when the troops were scattered over a large area outside Constantinople, malaria was a very serious source of disability, but with the withdrawal of the troops into proper barracks in the town area the number of fresh infections in 1921 and the first half of 1922 was very small. When the troops were moved a rapid increase in the number was inevitable.

The average number of blood-films examined per annum in the central laboratory was about 1,000.

In 1920 1	in every	4·0	films	was positive.	
1921 1	,,	8·0	,,	,,	(1·5 per cent M.T., rest B.T.)
1922 1	,,	4·6	,,	,,	(9·0 ,, ,, ,,)
1923 1	,,	4·0	,,	,,	(8·0 ,, ,, ,,)

The parasite of quartan fever was seen very occasionally (four times in Kilia and three times in Constantinople). Had the occupation not ended in September the figures for 1923 would have been much higher. The average number of films examined at Kilia was about the same as in the central laboratory. Owing to the large amount of dust and fine sand blown about it was found very necessary to use fresh double distilled water for diluting the Leishman's stain in order to get satisfactory preparations.

Venereal Disease Work.

Wassermann examinations constituted the bulk of the work in this group as the routine examination of gonococcal smears was made at the venereal disease hospital. The Wassermann reaction was carried out weekly after the manner of McIntosh and Fildes, measuring each quantity with a pipette or burette—and an average of 2,750 were examined each year. Considerable numbers of these tests were carried out for the Royal Navy in conjunction with the Fleet Medical Officer. The results were worked out quantitatively and standardized in conjunction with the Naval laboratory in Malta in order that the effects of various arsenobenzol compounds upon the Wassermann reaction might be judged. The drug being given by the subcutaneous, intramuscular and intravenous routes.

Flocculation tests were carried out as the opportunity arose, but were only done as controls of the Wassermann test and not as a routine.

Originally the dark-ground examinations for the spironema were carried out in the venereal hospital, but owing to the lighting difficulty it was decided to do all that work at the central laboratory where a small arc lamp was installed. Serum was collected from the sore in capillary tubes and forwarded to the laboratory for examination. If the first examination was negative another specimen was taken after an interval of twenty-four hours. If necessary further examinations were made. During 1922 it was decided to examine every penile sore in this way and it would appear that the results obtained justified this:—

In 1920	40 sera were examined and	*Spirochæta pallidum*	found in	10 cases.		
1921	156	,,	,,	,,	20	,,
1922	250	,,	,,	,,	55	,,
1923	501	,,	,,	,,	42	,,

(January to September.)

Sandfly Fever.

Each late spring and summer large numbers of cases of this infection occurred, and as would be expected most of the cases were found in the towns. As a matter of fact the disease was practically confined to two barracks, which for military reasons could not be entirely evacuated, the

only satisfactory method of prophylaxis. The enormous cost which would have been involved in repointing buildings, levelling broken ground, etc., for the destruction of breeding grounds of the phlebotomus fly was not found justifiable.

Blood films from every case were examined for the possible presence of parasites and for blood changes. The case which was clinically typical of pappataci fever invariably showed a leucopenia with a relative increase in the mononuclear cells, but many other not quite so typical cases occurred in the sandfly season which were frequently labelled sandfly fever and showed an early leucocytosis. In these one could not find absolute evidence of association with the phlebotomus; and it is doubtful if they were true cases of sandfly fever.

Considerable numbers of early blood cultures of cases were examined by citrated methods, animal inoculation, etc., but with negative results.

Enteric Group.

The inoculation state of the Army was always very high and infections of this group were few, paratyphoid infections were far more common than typhoid. Blood culture was attempted in every case, but owing possibly to the high inoculation state of the troops was not successful in seventy-five per cent. of the cases. In the case of the mercantile marine, etc., who were poorly protected, blood culture was successful in almost every case. The routine method finally adopted was cultivation in pure ox bile. At the slaughter-house a ligature was placed round the duct and the gall bladder dissected completely away and brought directly to the laboratory. The surface was seared and the bile removed aseptically into small sterile flasks. These were incubated and subsequently tested for sterility before being filled into ten-cubic-centimetre serum flasks. It was found that after sterilization the bile was not such an efficient medium. In our hands this method gave better results than taurocholate, trypsin or oxalate methods. A supply of these flasks was sent to each hospital. After five cubic centimetres of blood had been introduced at the bed-side through the broken tip of the neck, the flask was resealed with sealing wax and forwarded to the laboratory. Delay was not so very serious as the organisms multiplied very rapidly in this medium. Paratyphoid A appeared the most difficult to cultivate from the blood and frequently diagnosis had to be made upon a series of agglutination tests and on the recovery of the organism from the fæces, etc. Paratyphoid A occurred in two strains, one very inactive hardly ever producing gas and taking ten days or more to ferment dulcite and the other from kelia which produced gas very readily. Serologically they were both agglutinated to titre.

Paratyphoid B grew readily in blood culture and was regular in its reactions.

Paratyphoid C was isolated with some frequency in 1920, whilst the original Salonica force was in occupation. Later when this force was replaced by fresh troops Paratyphoid C was no longer found.

Bacillus fæcalis alkaligenes was isolated from blood cultures in two cases whose clinical picture suggested an enteric group. It was generally found that in unprotected persons the organism could be recovered from the blood very late in the disease if the temperature had not remitted.

CHOLERA AND PLAGUE.

Although the Army did not contract either of these two diseases, the infection occurred amongst the civilian population and a prophylactic vaccine against both cholera and plague was prepared in large quantities in the central laboratory and the troops were inoculated.

With regard to plague, which occurs sporadically in Constantinople, every effort was made in conjunction with the Sanitary Commissioner to find infected rats, but with negative results. Owing to the enormous prevalence of bed bugs large numbers of experiments were carried out to discover if the bugs transmitted the disease. The experiments produced no evidence of transmission.

SMALLPOX.

A serious epidemic of smallpox in 1922-3 amongst the civilian population produced a certain number of cases in the Army. The disease was of a very virulent type, but vaccination was very complete and there was only one death amongst the Army cases. One point in the treatment was the daily painting of the whole body with 1/200 solution of potassium permanganate. The results on the whole were very satisfactory.

RESPIRATORY DISEASES.

This group of diseases was uncommon in Turkey throughout the period under review. It is true that one hill regiment of Indian troops suffered extensively from tuberculous disease, but the infection was generalized and not confined to the lungs. There was a large amount of pulmonary tuberculosis amongst the natives employed, but there was no evidence that any one of the few cases of tubercle in the British Army was recently infected.

In 1921 a troopship arrived with practically all the troops infected with influenza. It was a very mild infection and mass isolation entirely prevented any spread. Sample post-nasal swabbings in fifty early cases showed *B. pfeiffer* to be the predominating organism in about fifty per cent.

Pneumonia and pleurisy were so infrequent that they call for no note.

Diphtheria occurred in sporadic form in the Army and was of a very mild type. In the routine sample swabbing of contacts, one was struck by the number of avirulent forms of Klebs-Loeffler bacillus isolated from healthy people. Between January, 1921, to September, 1923, Klebs-Loeffler bacillus was isolated from seventy-three throats or noses, twenty-eight of these cultures appeared to be absolutely non-virulent. There was a small outbreak in one of H.M. battleships in which a mess servant (a virulent carrier) infected about half the gun-room. The very prompt measures of

putting the "gun-room" ashore in a camp completely prevented the spread of the infection.

Relapsing Fever.

Two or three cases occurred each year, but apart from the cases from Russian camps, no epidemic was seen. The spirochæte was always found with comparative ease during the pyrexial period.

Vincent's Disease.

The fusiform bacillus and spirochæte of Vincent were found together in a variety of conditions, chiefly in ulcerative tonsillitis, ulcerative stomatitis and gingivitis, and ulcerative balanitis. All these conditions were fairly common. On the whole the "infection" responded very well to arsenobenzol compounds, the lesion being free from these organisms after two doses 0·45 gramme of sulfarsenol had been given. The lesions invariably contained other organisms besides those of Vincent, and it was frequently found, especially in the gingivitis cases, that a streptococcus would persist after the other organisms had disappeared and that after a lapse of time the Vincent organisms would again be found in the gums in as large numbers as before. This sequence of events was met by vigorous local treatment and the employment of autogenous vaccines. These results would suggest that Vincent's organisms frequently are not primary infecting agents.

Anthrax.

During the year 1923, four cases of malignant pustule occurred amongst the troops. Anthrax was prevalent to a certain extent in the horses and mules and the fact that the organism was not found in any of the shaving brushes examined and also the fact that all the cases were possible contacts of cases in animals, point to the horse or mule as the infecting agent.

In each case cultures were taken from the blebs and grown on artificial media and also inoculated into a guinea-pig. The organism was highly virulent. 0·1 cubic centimetre of either the serum or of a twenty-four hours broth culture killed a 250-gramme guinea-pig in less than twenty-four hours.

Blood cultures were taken in each case, but anthracæmia was not found.

The treatment was entirely non-surgical. Three of the cases were treated with a single dose of fifty cubic centimetres of anti-anthrax serum subcutaneously and a local carbolic compress and the fourth with the local compress only. Every case made a complete and uninterrupted recovery.

Jaundice.

Apart from ordinary catarrhal jaundice there was a type that occurred in the summer months which had a curious onset, etc. The disease was not associated with any intestinal disturbance, but was always preceded by a short pyrexial period which had subsided three to seven days before the jaundice appeared. A few of the patients were rather miserable during

the first day of the jaundice, but both the symptoms and the colour itself cleared up very quickly.

There was a slight early leucocytosis (10,000 per cubic centimetre) with a relative increase of six to nine per cent in the large mononuclears. Urine, fæces, and blood examinations were carried out in most of the cases, but there were no abnormal findings. Triple centrifugalization of the blood and examination by dark-ground methods failed to show any spirochætal infection.

The disease was far more common in officers and officer's wives than amongst the troops.

Agglutination Tests.

The routine method was that of Dreyer, but the Oxford standard emulsions were not used—the bacterial emulsions were prepared in the laboratory, and each batch standardized against the previous batch. The large majority of these tests were against the typhoid group, in which case it was the rule to make at least three tests with weekly intervals. Malta fever and dysentery group agglutinations were also carried out in the same manner, but with different incubation times.

The Weil-Felix reaction was carried out in every case of suspected typhus fever, of which there were considerable numbers in 1920. The original technique was followed with a culture of *B. proteus* X 19 obtained from the Austrian Hospital in Constantinople in 1919. It was rare to obtain a positive reaction before the 6th day of the disease, and then only in a low dilution, but by the 8th to 9th day the titre was usually 1-500. Every case of typhus that gave a positive clinical picture gave a positive Weil-Felix reaction. Very large numbers of agglutination tests were also performed for the identification of organisms, etc.

Vaccine Therapy.

With the exception of the mixed gonococcus vaccine almost all the attempts at active immunization were carried out with autogenous vaccines. In 170 successive cases of furunculosis so treated 140 were reported as cured or markedly improved, the remaining thirty showed no change.

Twenty-five cases of common cold were treated and fourteen of the cases considered themselves to be greatly improved in general health with almost complete relief from colds.

Just over a thousand cases of gonorrhœa treated with a mixed gonococcus vaccine and compared with about 200 other cases with identical treatment, except that the vaccine was not given, failed to show any benefit from the vaccine, either in shortening the time in hospital or in effecting a more thorough cure. On the other hand the small number of cases (primary) treated from the very first moment with vaccine, and with an autogenous vaccine on the third day, were distinctly promising in their results.

Post-mortems and Histology.

All post-mortem examinations in the Constantinople area were carried out by the central laboratory and those in the Kilia area by the district laboratory. They averaged about thirty per annum. The histology in connexion with these and any growth, etc., removed at surgical operations was carried out at the central laboratory.

Chemical Work.

For the most part this was just the routine work such as is carried out in a hygiene laboratory, i.e., analysis of foods, drugs, etc., together with a small amount of chemical pathology.

Travel.

DAGSHAI, SIMLA HILLS.

By Major J. E. M. BOYD, M.C.
Royal Army Medical Corps.

Dagshai is one of the smaller hill-stations near Simla, and is situated in the Sub-Himalayan Range, on the top of a ridge running east and west. It is ten miles from Kasauli, and eighteen miles from Kalka by road. Latitude, 30 deg. 58 min. 4 sec.; longtitude, 77 deg. 2 min. 3 sec. approximately; altitude, 6,087 feet above sea level.

The climate is temperate throughout the year; in the hottest months, May and June, the temperature rarely rises above 80 degrees, and in the winter the minimum is about 35 degrees in the early morning and 50 degrees at mid-day.

The most unpleasant period is during the monsoon, which commences early in July and ends in the middle of September; this year there was an extra downpour, commencing on September 27, during which 17½ inches of rain fell in sixty-three hours. This downpour did very great damage throughout the district, railways, roads and houses being very much damaged, and for some days transhipments of passengers and baggage were necessary.

The average rainfall is about 67½ inches, of which the greater part falls during the monsoon. This year there were 12·23 inches in August and 24·64 inches in September.

Snow falls during the winter months, but does not remain long on the ground, most of it melting in two or three days; during these months the air is dry and bracing.

The cantonment is built on two hills running east and west, and surrounding these two hills is a flat road, somewhat in the shape of a figure

eight, placed horizontally; at the junction of the two loops of the figure eight—three other roads join in, one from the more eastern or "Officers Hill," one from the western or "Soldiers Hill," leading directly up to the British Station Hospital; this hill is very steep and is called "Palpitation" Hill, and well it earns its name—the third road comes up from Kumahatti Railway Station, on the Kalka-Simla Railway.

The targets on the rifle-range are on the side of this last road, so that when firing is in progress it is not possible to get past until the firing has been stopped. When competitions are in progress, it is often not possible to cease fire immediately, and so several persons have missed their trains at Kumahatti on this account.

The "overs" from the range pass over the Government butchery, and it is at times unpleasant to visit the butchery incinerator, as a bullet can often be heard coming towards one, and naturally one wonders whether it will go high over one's head or not. Stray bullets are all very well and do not worry one very much on service, but are unpleasant visitors in cold blood.

On the western, or Soldiers Hill, are, in addition to the barracks, which are chiefly single-storied buildings, only two blocks being double-storied, the British Station and Family Hospitals, married quarters, some single and others double-storied, Church of England and Roman Catholic churches, gymnasium, which is largely used for dances and other entertainments, as well as for its legitimate purpose—institutes, canteen, sergeants' and corporals' messes, S.S.O. and executive officers' offices, and a large parade ground, on which football is played in the afternoon.

At the extreme western end is the local piggery, and on the northern slope the Suddar Bazaar. The latter is like all others of its kind, and contains shops for the sale of meat, fruit, vegetables and other foodstuffs, and, of course, has the ubiquitous Kashmiri "box walla," with his collection of curtains, Persian rugs (usually "faked"), skins and old (?) brass, the latter having rapidly become "ancient" through burial and other modern devices; still, if one is careful, very good bargains may frequently be had from these men. The population of the bazaar in the season is about 2,000.

The old Detention Prison stands to the east and slightly above the level of the Suddar Bazaar; this is closed now and used by the transport section of detachments doing duty here. In November, 1920, it was the place selected for the execution of a British soldier belonging to a famous regiment, now disbanded, who was sentenced to death by a general court-martial for mutiny.

Again to the east of the Detention Prison are built the Government butchery and bakery buildings. The Post and Telegraph Office is situated on the same hill, a short distance down the Kumahatti road.

The eastern or Officers Hill is dotted over with the residential bungalows of officers and civilian residents. Near Charing Cross is the S.C.A.

Institute which is comfortable and clean and well patronized by the troops. On a small spur to the south-east of this hill is the Government dairy, and further still to the east the new military cemetery.

A large recreation ground, made many years ago by a battalion of the Highland Light Infantry, is also situated at the eastern end of Officers Hill. Except for the garrison sports this is not largely used, as it is about one-and-a-half miles from barracks, but Indian followers occasionally use it for football.

There are two railway stations nearby, one at Dhurrampore, 3½ miles, and the other at Kumahatti, one mile, both on the Kalka-Simla Railway.

There are three hospitals, the British Station Hospital, Station Family Hospital, both pleasantly situated at the top of Soldiers Hill, with delightful views of the perpetual snows on a long range of mountains behind Simla and Subatu—and the Cantonment General Hospital in the Suddar Bazaar.

The British Station Hospital has thirty-five beds, the Family Hospital eight, of which two are set aside for the use of officers' wives, should they be required, there is also an officers' ward at the British Station Hospital containing two beds. During this season neither the ward for officers nor that for their wives have been used, as only one officer has been placed on the sick list, the officer commanding the British Station Hospital, who was treated "in quarters" for malaria.

On the whole the health of the troops has been good, the only prevailing disease having been malaria. This accounted for 277 admissions out of a total of 410. All were relapse cases from the Plains.

There was a small outbreak of rabies during the season, due to a dog, previously bitten by a rabid dog at Sialkot, having been brought up here by its owner. Eleven cases of suspected rabies in dogs were seen, of these 6 were found positive on examination of the brain, 1 was doubtful, the remainding 4 for various reasons were not examined. Ten British other ranks, 5 women, 9 children and 5 Indians were sent to the Pasteur Institute at Kasauli for treatment.

The food supply for troops is, as usual, in the hands of the Indian Army Service Corps, and is satisfactory—during the season a good variety of fresh vegetables is available, the only complaint made was on account of the bread, which at first, owing to old flour having been sent up, as is so often the case in hill stations, was sour and very moist; this was, however, soon remedied. Officers and civilian residents obtain fruit and vegetables from the bazaar. When in season apples, bananas, apricots and peaches are available, and also French beans, green peas, cauliflowers and tomatoes. Apricots and peaches grow wild on the hill-sides, so were at times responsible for some cases of colic amongst troops and children. Very good looking watercress also grows at the foot of the hill, near Kumahatti, but owing to the local conditions of the stream the sale is absolutely forbidden in the cantonment area.

The expenses are very much lower than in most other stations in the Punjaub.

There is no water on the two hills, but a very excellent, if inadequate, supply is obtained from enclosed springs on a hill about five miles away. It is brought in by a pipe line to storage tanks near Kumahatti, flowing in by gravitation. It is chlorinated as it runs into these tanks by regulated drip-cocks, and is then pumped up into two pairs of tanks, situated one above the Suddar Bazaar and the other near the hospital.

The capacity of each pair of tanks is 70,000 gallons. From these tanks the water is carried by pipes to various parts of the station and is collected by bhistis from stand-pipes and carried to the bungalows in buckets. The use of mussacks is forbidden.

There are cisterns with ball-taps attached to each cook-house, wash-house and to married quarters.

The intake at the pumping station varies from 900 to 1,500 gallons an hour; when the former amount is running in, the percentage of chlorine is usually excessive, the drip-cocks not being automatic and being set for 1,500 gallons—the life of the O.C. British station hospital is at these times not worth living, as complaints that the "water tastes horrid" are frequent.

The supply from the upper tanks is intermittent, being turned on only twice daily; this is due to the fact that the pumping engines are old, one is usually under repair and no one knows when the other is going to stop functioning. This cold weather it is proposed to put in new engines, so in future the supply may be improved.

There is a large wastage of water from the pumping station, owing to the pumps not being able to deal with the whole of the intake; a proposal has been put forward that a swimming bath be built, to allow men to enjoy the pleasure of a swim, near the pumping station, the nearest swimming pool being at present about six miles away.

Some appliances have been asked for to improve the sanitation, which, though good on the whole, might be made better by the provision of more incinerators. At present there are only four, two on each hill, and as rubbish and excreta have to be carried by sweepers, in some cases a considerable distance, it is doubtful if, in the rains especially, some of the filth cans ever reach their destination, the "carry" is long, undergrowth on the khudside is thick and the average Indian not noted for excessive zeal.

The average strength of the garrison has been about eight hundred throughout the season, made up of detachments of the 2nd Battalion Northamptonshire Regiment from Lahore and the 2nd Battalion King's Own Yorkshire Light Infantry from Ferozepore, in addition there were about eighty families from Lahore, Ferozepore, Sialkot and Ambala, so the two medical officers doing duty were kept fairly busy, especially as there being no civil surgeon, they were called in to see any civil cases that might require treatment, but luckily these calls were few in number.

During the season football matches, boxing, concerts and other amusements were arranged for the troops, local talent was good but in addition concert parties came over from Kasauli and Solon.

Dances were also held weekly in the gymnasium, both by the serjeants' mess and for British other ranks generally.

There is an officers' tennis club on Officers Hill, two very good mud courts being available—and owing to a bungalow, previously used as an officers' mess, being empty, dances were held there occasionally, there were also one or two very successful fancy dress dances. There is no Club House—but officers and civilians with their wives used to meet at the tennis courts, and life was peaceful as a rule.

Prior to the rains, a few picnics were arranged including "mixed" bathing in a deep pool about six miles from cantonments; the walk there was very pleasant, but the return journey was trying, as the first 2½ miles were up hill, on the sunny side of the hill, and the heat was considerable. The bathing pool was considered by some to be similar in one respect to the Pyramids in Egypt—in that one visit was sufficient.

The M.E.S. and serjeants' mess also had tennis clubs and some very good tournaments were arranged between these clubs, and also at the officers' club.

There is little or no shooting, as during the close season, which covers practically the whole period during which the station is open, no shooting is allowed, and after that many birds, as the black partridge, have left; there are, however, a few kalij pheasants, jungle fowl and chicken. Outside the cantonment area, all land belongs to Indian States and permission has to be asked before shooting is allowed.

Regarding larger game a few leopards, foxes, jackall and barking deer are occasionally seen or heard, but in the warmer months are not worth shooting.

May and October are the most pleasant months, though the former may be uncomfortably warm. In October the hillsides are a mass of wild cherry trees in full bloom and look very beautiful; as stated before, apricots and peaches grow wild, medlars, walnuts and wild pomegranates are also found. As regards flowers, zinnias and dahlias are found on the hillsides, but whether local or derived from garden seeds is doubtful, English flowers, roses, honeysuckle, geranium and cosmos do well—some of the plants of the latter growing to over 7 feet in height; mixed with English plants are found cactus, lilies and other tropical species.

Natural history specimens are well represented, though birds are not very common, the crow, chil or house kite, minahs and tom-tits being the most common, with an occasional eagle and vulture. Most beautiful butterflies and moths, for which the Simla Hills are noted, may be seen in large numbers.

Flies are in abundance in barracks and houses, though strangely enough before the rains these consist chiefly of some species of anthomyia, but

during the rains musca is the commonest genus seen. Other diptera found include calliphora and lucilia, which are not common, tabanids and bombilidæ. Culex mosquitoes are fairly common and troublesome. Only one species of anopheles was found during the season; this proved to be *Anopheles lindesii.* Sandflies are common, but apparently uninfected. Fleas are common in the rains, and most barracks, married quarters and bungalows can show the presence of bugs.

A few scorpions were caught and a few snakes, the cobra and Russell's viper being the only two poisonous species collected.

The views are good from the hill tops. To the north and north-west is the snowy range behind Simla, the latter place being visible from the serjeants' mess. To the south-west is Kasauli, with "Tap's Nose," a high hill near by. To the south is an excellent view of the plains, which can also be seen to the south-east. To the east one sees in the distance the Chakrata hills, behind which lies Moussourie.

This year the season closes on November 3, and the writer will leave with mixed feelings; the cold evenings and nights are rather trying, but the peaceful life and low prices are not easily found in India.

Echoes of the Past.

SUVOROFF'S CATECHISM.

By Major O. TEICHMAN, D.S.O., M.C.
Royal Army Medical Corps (T.A.).

Alexander Vasilisvitch Suvoroff was born at Moscow in 1729; his father was a general and a senator, and must have been well educated for those times, as he actually translated Vauban's works into Russian. The young Suvoroff entered the army as a private at the age of seventeen, but rose rapidly in rank after the Seven Years' War. He served with distinction in the first Polish War, but nearly lost his life in that campaign. Suvoroff was besieging Cracow, which had been captured by the French, when suddenly the Polish Colonel Kossakowski appeared at the head of his celebrated Black Hussars; the Russian general, without waiting to collect more mounted troops, immediately charged with two squadrons of Lancers and some Cossacks, but in the heat of the action a Polish officer, having sworn to take his life, rode fiercely at him, and after discharging his pistols without effect, attacked him with his sabre. Suvoroff crossing swords with alacrity, returned blow for blow and thrust for thrust, but must have succumbed to his vigorous assailant had not a Russian cuirassier galloped up in the nick of time and struck the officer from his horse.

After several successful campaigns which included the capture of Praga (Warsaw) and the famous siege of the Turkish fortress of Ismail, we find Suvoroff in Italy (1799) assisting the Austrians in opposing the French.

As soon as he arrived on the Mincio with the first division of his forces, twenty thousand strong, he took command of all the allied troops in Italy. The jealousy of the Austrian generals was naturally excited, and they called a council of war in order to examine his plans. The members of the council, beginning at the youngest, proceeded to propose their several schemes. Suvoroff quietly heard them all, and when they had done took a slate and drew two lines, and said, "Here, gentlemen, are the French, and here the Russians; the latter will march against the former and beat them." So saying, he rubbed out the French line, and added, "This is my plan; the council is concluded." Suvoroff kept his word, and in less than three months swept the French entirely out of Lombardy and Piedmont.

He defeated Moreau on the Adda, Macdonald on the Trebbia, and Joubert at Novi, but was finally, after fearful sufferings and heavy losses, forced to retreat from Switzerland over the mountains into Austria by Masséna.

On his return to Russia he died at St. Petersburg in 1800. Suvoroff was the idol of his soldiers and was never defeated, only once in his life having to act on the defensive. His character has been much abused by the French, but one must remember that they were his natural enemies, and that their accounts being much more widely understood than the Russian, from which the truth can be gathered, enjoy a wider publicity.

As a young man, having neither good looks, riches, nor exalted birth to forward his career, he was wont to assume the character of a buffoon in order to captivate the public gaze; this characteristic he maintained throughout his life, and thus enhanced his popularity with the troops. He generally closed his harangues by endeavouring to excite laughter among his soldiers; this mode of forming a climax being in those days a peculiar characteristic of Russian speeches.

In the following speech, known as the "Discourse under the Trigger" (the harangue made by a general to his troops, "When the line is drawn out, and the soldiers rest on their pieces"), Suvoroff thoroughly lives up to his reputation; it consists of a series of instructions drawn up by himself for the use of the army under his command, after the Turkish War (1790), and subsequently transmitted, by order of the Russian Government, to every regiment in the service. This was commonly known as Suvoroff's Catechism, and apparently in those days corresponded to our present "Field Service Regulations, Part II." Lord Haig in his final despatch says: "Only by the rifle and bayonet of the infantryman can the decisive victory be won." Suvoroff, one hundred and thirty years ago, appears to have held the same view, but placed the bayonet before the rifle; he stated, however, that "the cavalry must generally make the first attack, and when the battle is gained must pursue and hack the enemy."

Discourse under the Trigger.

(Mainly after Clarke's translation from the original Russian.)

The General is inspecting the line, and addressing the troops: "Heels close—knees straight! A soldier must stand like a dart!—I see the fourth —the fifth I don't see!

A soldier's step is an 'archine'—(28 inches), in wheeling an 'archine' and a half. Keep your distances well!

Soldiers, join elbows in front! First rank three steps from the second— in marching, two! Give the drum room!

Keep your ball three days:—It may happen for a whole campaign, when lead cannot be had!

Fire seldom—but fire sure!

Push hard with the bayonet! The ball will lose its way—the bayonet never! The ball is a fool—the bayonet a hero!

Stab once? and off with the Turk from the bayonet! even when he's dead you may get a scratch from his sabre.

If the sabre is near your head, dodge back one step, and push on again. Stab the second!—stab the third! a hero will stab half a dozen.

Be sure your ball is in your gun! If three attack you, stab the first, fire on the second, and bayonet the third!—this seldom happens.

In the attack there's no time to load again.

When you fire, take aim at their guts; and fire about twenty balls— buy lead from your mess treasury—it costs little! We fire sure—we lose not one ball in thirty. In the Light and Heavy Artillery, not one in ten.

If you see the match upon a gun, run up to it instantly—the ball will fly over your head—the guns are yours—the people are yours! Down with 'em upon the spot! pursue 'em! stab 'em!—To the remainder give quarter—it's a sin to kill without reason: they are men like you.

Die for the honour of the Virgin Mary—for your Mother (the Empress)—for all the Royal Family!

The Church prays for those that die: and those who survive have honour and reward.

Offend not the peaceable inhabitants! they give us meat and drink—the soldier is not a robber.—Booty is a holy thing! If you take a camp, it is all yours! if you take a fortress, it is all yours! At ISMAIL, besides other things, the soldiers shared gold and silver by handfuls: and so in other places; but, without order, never go to booty!

A battle in the field has three modes of attack.

(1) *On the wing*, which is weakest. If a wing be covered by a wood, it is nothing; a soldier will get through.—Through a morass, it is more difficult.—Through a river you cannot run. All kinds of intrenchment you may jump over.

(2) *The attack in the centre* is not profitable—except for the Cavalry, to cut them in pieces—or else they will crush you.

(3) *The attack behind* is very good. Only for a small corps to get round. Heavy battle in the field, against regular troops. In squares against Turks, and not in columns. It may happen against Turks, that a square of 500 men will be compelled to force its way through a troop of 6 or 7,000, with the help of small squares on the flank. In such a case, it will extend in column. But till now we have had no need of it. There are the God-forgetting, windy, light-headed Frenchmen—if it should so happen to us to march against them, we must beat them in columns.

The Battle, upon Intrenchments, in the Field.—The ditch is not deep—the rampart is not high—down in the ditch! jump over the wall! Work with your bayonet! Stab! Drive! Take them prisoners! Be sure to cut off the cavalry: if there are any at hand—at Praga, the infantry cut off the cavalry: and there were threefold, and more, intrenchments, and a whole fortress; therefore we attacked in columns.

The Storm.—Break down the fences! Throw wattles over the holes! Run as fast as you can! jump over the palisades! Cast your faggots! (into the ditch). Leap into the ditch! Lay on your ladders! Scour the columns! Fire at their heads! Fly over the wall! Stab them on the ramparts! Draw out your line! Put a guard on the powder cellars! Open one of the gates! The cavalry will enter on the enemy. Turn his guns against him! Kill every enemy in the streets! Let the cavalry hack them! Enter no houses! Storm them in open places, where they are gathering. Take possession of the open places! Put a capital guard! Instantly put picquets to the gates, to the powder cellars and to the magazines! When the enemy has surrendered, give him quarter! When the inner wall is occupied go to plunder!

There are three military talents:—

(1) *The Coup d'Œil.*—How to place a camp—how to march—when to attack—to chase and to beat the enemy.

(2) *Swiftness.*—The field artillery must march half or a whole verst in front, on the rising ground, that it may not impede the march of the columns. When the column arrives it will find its place again. Down hill and on even ground, let it go at a trot. Soldiers march in files or four abreast, on account of narrow roads, streets, narrow bridges and narrow passes through marshy and swampy places; and only when ready for attack draw up in platoons to shorten the rear. When you march four abreast, leave a space between the companies. Never slacken your pace! Walk on! Play! Sing your Songs! Beat the drum! When you have broken off ten versts the first company cast off their loads and lie down. After them the second company; and so forth, one after the other. But the first never waits for the rest. A line in columns will on the march always draw out. At four abreast it will draw out one and a half more than its length. At two abreast it will draw out double. A line one verst in length will draw out two—two versts will draw out four; and so the first companies will have to wait for the others half an hour to no purpose. After the first

ten versts an hour's rest. The first division that arrived (upon the coming of the second) takes up its baggage, and moves forward ten or fifteen paces; and if it passes through defiles, on the march, fifteen or twenty paces. And in this manner, division after division that the hindmost may get rest. The second ten versts, another hour's rest or more. If the third distance is less than ten versts, halve it, and rest three-quarters, half or a quarter of an hour; that the children may get to their kettles. So much for infantry.

The cavalry marches before. They alight from their horses and rest for a short time, and march more than ten versts in one stage, that the horses may rest in camp. The kettle waggons and the tent waggons go on before. When the brothers arrive the kettle is ready. The master of the mess instantly serves out the kettle. For breakfast four hours' rest—and six or eight hours at night, according as the road proves. When you draw near the enemy the kettle-waggons remain with the tent-waggons, and food must be prepared beforehand. By this manner of marching, soldiers suffer no fatigue. The enemy does not expect us. He reckons us at least a hundred versts distant; and when we come from afar, two hundred, or three hundred, or more, we fall all at once upon him, like snow on the head. His head turns. Attack instantly with whatever arrives; with what God sends. The cavalry instantly fall to work—hack and slash! Stab and drive! Cut them off! Don't give them a moment's rest.

(3) *Energy.*—One leg strengthens the other! One hand fortifies the other! By firing many men are killed! The enemy also has hands, but he knows not the Russian bayonet! (alluding to the Turks). Draw out the line immediately, and instantly attack with cold arms! (the bayonet). If there be not time to draw out the line, attack, from the defile, the Infantry with the bayonet, and the cavalry will be at hand. If there be a defile for a verst, and cartridges over your head, the guns will be yours. Commonly, the cavalry make the first attack, and the infantry follow. In general, cavalry must attack like infantry, except in swampy ground, and then they must lead their horses by the bridle. Cossacks will go through anything. When the battle is gained, the cavalry pursue and hack the enemy, and the infantry are not far behind. In two files there is strength, in three files strength and a half. The first tears, the second throws down, and the third perfects the work.

Rules for Diet.—Have a dread of the hospital. German physic stinks from afar, is good for nothing, and rather hurtful. A Russian soldier is not used to it. Messmates know where to find roots, herbs, and pismires. A soldier is inestimable. Take care of your health! Scour the stomach when it is foul! Hunger is the best medicine! He who neglects his men—if an officer, arrest; if a sub-officer, lashes; and to the private lashes, if he neglects himself. If loose bowels want food, at sunset a little gruel and bread. For costive bowels some purging plant in warm water, or the liquorice root. Remember, gentlemen, the field physic of Doctor Belly-potsky! In hot fevers eat nothing, even for twelve days—and drink your soldier's quass—that's a soldier's physic.

For intermittent fevers neither eat nor drink. It is only a punishment for neglect, if health ensues. In hospitals the first day the bed seems soft, the second comes French soup, and the third the brother is laid in his coffin, and they draw him away! One dies, and ten companions round him inhale his expiring breath. In camp the sick and feeble are kept in huts, and not in villages; there the air is purer. Even without an hospital you must not stint your money for medicine if it can be bought—nor even for other necessaries. But all this is frivolous—we know how to preserve ourselves! Where one dies in a hundred with others, we lose not one in five hundred in the course of a month. For the healthy, drink, air, and food; for the sick, air, drink, and food. Brothers, the enemy trembles for you! But there is another enemy, greater than the hospital—the damned 'I don't know!' From the half-confessing, the guessing, lying, deceitful, the palavering equivocation, squeamishness, and nonsense of 'Don't know!' many disasters originate. Stammering, hackering—and so forth; it's shameful to relate! A soldier should be sound, brave, firm, decisive, true and honourable! Pray to God! from Him come victory and miracles! God conducts us! God is our General! For the 'I don't know!' an officer is put in the guard—a staff-officer is served with an arrest at home. Instruction is light. Not instruction in darkness! The work fears its master! If a peasant knows not how to plough, the corn will not grow! One wise man is worth three fools! and even three are little; give six! and even six are little; give ten! One clever fellow will beat them all; overthrow them and take them prisoners!

In the last campaign the enemy lost 75,000, well-counted men—and, perhaps, not much less than 100,000. He fought desperately and artfully, and we lost not a full thousand. There, brethren, you behold the effect of military instruction! Gentlemen, officers, what a triumph!"

Clarke remarks that it is impossible in this (literal) translation, consistently with fidelity, to preserve the brevity and energy of the original Russian.

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Reports and Analyses.

"SOLOID" URINE-SUGAR TEST CASE.

THIS case combines simplicity with utility and has been specially designed by Messrs. Burroughs Wellcome and Co. for those diabetics who are under insulin treatment at home. The case is made of stout cardboard and contains a liberal supply of tests, twenty-four in all.

The full contents are as under :—

Two tubes of " Soloid " alkaline citrate.

One tube of " Soloid " copper sulphate.

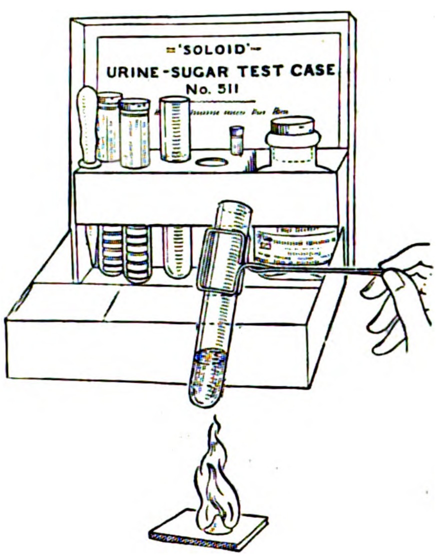
One medicine dropper with rubber bulb.

Two test tubes, graduated.

One wire test tube holder.

One small square of asbestos.

One bottle of twenty-five " Soloid " hexamethylenetetramine (one of these placed on the asbestos square will burn for three minutes, sufficiently long to conduct one test).



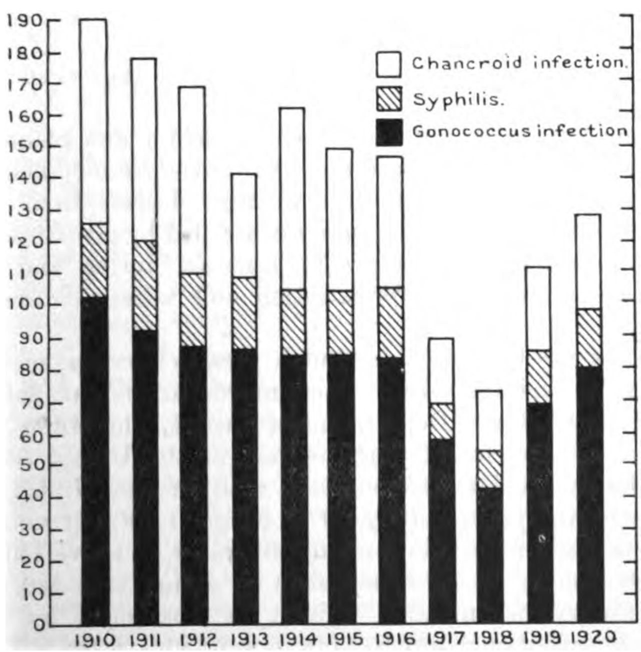
The test is stated to be very reliable, and amounts as low as 0·1 per cent of glucose are read with ease. The introduction of a simple heating medium, obviating the employment of methylated spirit, is a feature which will be readily appreciated. The flame is smokeless and therefore there is no tendency for the reading to become obscured.

The case is very compact, measuring 5 by $4\frac{1}{4}$ by $1\frac{1}{8}$ inches, and may easily be carried in the pocket.

Current Literature.—Hygiene.

The Experience of the United States Navy in the Prevention and Control of Venereal Disease during and since the World War.[1] By Lieutenant-Commander Robert F. Jones, Medical Corps, United States Navy. *The Military Surgeon*, p. 568, November, 1924.—Prophylactic treatment was first introduced in the United States Navy in 1907 and became universal by 1909.

A ruling was also introduced by which the pay of men suffering from venereal disease, due to their own misconduct, is cut when in hospital, and men are not allowed liberty or leave while infectious.



As will be seen from the chart there has been a steady decline in the incidence of venereal disease from 1910 to 1916 and a rapid decrease in 1917 and 1918, there is a slight increase in 1919 and 1920, and since then the figures have been practically stationary.

The causes to which the rapid decline of incidence of venereal disease in 1918 is attributed are given as follows :—

(1) Higher type of personnel and conditions which permitted appeal to patriotism.

[1] Paper read at the Congrès International de Médicene et de Pharmacie Militaires Rome, 1923.

(2) Less opportunity for liberty and leave on account of more active work.

(3) Compulsory venereal prophylaxis and frequent examination of the personnel for venereal disease.

(4) Punishment by court martial or otherwise of those contracting venereal disease who had not taken prophylaxis.

(5) The loss of pay by the individual when on the sick list with venereal disease.

(6) The more active interest of combatant officers in the control of venereal disease.

(7) The restriction of liberty of all men suffering with venereal disease.

(8) The prohibition of the sale of alcoholic liquors in the United States in and around naval stations and seaport towns.

(9) The repression of prostitution through the active co-operation of various official agencies—federal, state, and city governments as well as that of unofficial agencies.

The enforcement of all these factors is, with the exception of No. 9, possible in peace time.

The author lays great stress on this last factor and points out that all venereal infections among the military are derived from civilian prostitutes. Thus it is not possible to eliminate venereal disease from the military forces unless prostitution is thoroughly controlled by civilian authorities.

The organizations in existence in America during and immediately after the war for control of prostitution and venereal disease are then outlined :—

Those under the United States Public Health Services, such as venereal clinics, hospital facilities, &c.; The Interdepartmental Social Hygiene Board, The United States Department of Justice, The Mann Act.

The venereal disease rate for the men of the United States Navy is constantly higher in foreign countries than in the United States, the average rate being approximately 60 to 80 per 1,000 per annum for men in home ports and for those in foreign countries well above 150 per 1,000.

The author sums up his conclusions by saying that venereal diseases with the military organization cannot be controlled by the military authorities alone, but such military forces must obtain the full co-operation of the National Government, local governments, and of civic organizations, as well as the citizens of the country, in the control of prostitution.—D. H.

Epidemic of Virulent Smallpox in Windsor, Ontario and vicinity. By F. Adams, M.B., D.P.H., Medical Officer of Health for the Essex Border Municipalities, February, 1924 (*Ministry of Health*).—In the latter part of February, Windsor and vicinity experienced an outbreak of smallpox unusual in origin, often unusual in transmission, irregular in type, and shockingly virulent, but yielding, as all smallpox yields, to vaccination. This paper is an attempt to set forth the main features of this epidemic.

Origin of the Epidemic.—The origin of the epidemic was unusual. On February 2, G. D., a respected citizen of Windsor, fell ill with an extraordinary sickness, from which he died on February 11. He was seen during his illness by four physicians, including two experienced consultants. There is now no doubt that this man's illness was hæmorrhagic smallpox, but the disease was so irregular that it was not recognized. It was only when persons who had been in contact with G. D. became ill with the symptoms of smallpox that there was any suspicion as to the true nature of his malady. Very soon it became plain that the disease was not confined to the border cities, but had broken out in Amherstburg, Maidstone and Detroit, Michigan, U.S.A., all originating in the one missed case. The total number of cases of smallpox in all these places was sixty-seven and the number of deaths was thirty-two.

Difficulties in Diagnosis.—One of the outstanding features of this epidemic of smallpox was the irregular and unusual character of a large proportion of the cases, and it may be useful briefly to present some of the unusual cases.

To consider first the original missed case :—

Case 1, G. D.—This man took sick on a Saturday night with a violent headache, vomiting, sore throat and some general pains in the back and elsewhere. On Tuesday he broke out everywhere with a rash resembling urticaria, such as often follows the administration of diphtheria antitoxin. His whole body was covered by raised irregular blotches of all shapes and from a bean to an egg in size. On Wednesday this rash was a light brown in colour. His principal complaint was a persistent headache, sore throat and sore mouth. He had been troubled with repeated attacks of sore throat and his teeth had bothered him a great deal, and he had intended having them all out because of pyorrhœa. His temperature was about 101, he was perfectly rational, answered questions readily, even rose to laughing at a joke. He readily sat up in bed, opened his mouth, put out his tongue and said "ah" to have a throat swab taken. He was unvaccinated but gave no history of exposure to smallpox. There was no particular change in the symptoms except that the rash became darker as the days went by, and about two days before death occurred there was hæmorrhage from the bowels. The diagnosis made by all physicians who saw this man was purpura hæmorrhagica, and it was believed that the root of the trouble lay in the sore throat or bad teeth of the patient. It is to be remembered that this case came out of a clear sky, that each of the physicians who saw the case was experienced in the diagnosis of smallpox, and that in spite of this the diagnosis was completely missed. At no time during the epidemic which followed did a case occur that looked in the least like this first one —also that the source of infection of this initial case has not been discovered.

Case 2, J. I.—On Wednesday, February 20, this man took ill with severe headache and pain which the physician thought at first was in the

patient's back, but on further examination seemed to be in the abdomen extending down into the groin. He was unvaccinated, but gave no history of contact with smallpox, and was sent into one of our general hospitals as a case of surgical kidney. That was late Wednesday night or early Thursday morning. On Friday morning he broke out in an intense red rash which is so well described in the chapter on smallpox in Ker's Book of Infectious Diseases that the description is given verbatim :—

"A very interesting and ill-omened form of erythema, which is sometimes classed as scarlatiniform, but which has distinct characters of its own, is the rash which is called by French authors 'le rash astocoïde,' or the lobster rash. This is a very vivid and intense erythema, almost erysipelatous, of a most brilliant red colour, approaching more the tint of scarlet than anything ever seen in scarlet fever. It is general all over the body and involves also the face, which is usually congested and puffy. It only occurs in hæmorrhagic cases, and is therefore of grave prognostic signifilcance. It is early followed by hæmorrhages into the conjunctive, and later over the surface of the skin."

This patient died twenty-four hours later with hæmorrhages from the bowels and under the skin everywhere. His temperature never exceeded 101°. His total illness was under four days. He had never been vaccinated. He had been asked if he had been in contact with smallpox, and said "No." As a matter of fact he had visited Case No. 1, but at the time he took sick he did not know that G. D.'s illness was really smallpox.

Case 3.—On Sunday, February 24, M. B., a trained nurse, age 34, was sent from out of town into the other one of our general hospitals and had her appendix removed the same night. Hæmorrhage had occurred in the distal end of the appendix. During Monday night she broke out with a mixed kind of rash. Her face was flushed, as with scarlet fever, but with inflamed eyes. There was a rash on the body which resembled measles. She had come off a scarlet fever case two weeks before but believed that she had had scarlet fever as a child. She had no sore throat and no strawberry tongue. The inflamed eyes with a rash on the body rather pointed to measles, but there was no typical measles rash on the face, no spots in the mouth, no cold in the head, nor bronchitis. She had never been successfully vaccinated, but had not been exposed to smallpox as far as she knew. The case was not believed to be smallpox, but in view of the uncertainty of the diagnosis the case was isolated, and the nurse who was caring for her was vaccinated at once. Wednesday: the patient continued much the same. Thursday: it was learned that the patient's brother had smallpox and the home was in quarantine. Friday: there was blood in the urine, and on that day we allowed the patient to go home, where she died a few days later. Exposure to smallpox was traced later.

Case 4.—At about the same time a man was sent into one of our general hospitals vomiting blood and passing blood from the bowel. He had a fever of 1½° and no history that would point to gastric ulcer or

anything of that kind, and no signs or symptoms that would point to typhoid. He had been vaccinated successfully in childhood, and again about ten years ago, and still again since the beginning of the epidemic, last vaccination not having taken. The patient was thirsty, and had the typical appearance of a straight hæmorrhage case, but not knowiag precisely what was wrong with him we had him strictly isolated. Later on we concluded that his hæmorrhage was due to taking 105 grains of aspirin in fifteen hours. He recovered.

These cases will, I think, serve to illustrate some of the difficulties we had in the way of diagnosis in the presence of an epidemic of irregular smallpox. Ordinarily the differential diagnosis of smallpox is from influenza, chicken-pox, drug rashes, and perhaps syphilis and impetigo. These were not the diseases we had to consider, but scarlet fever, measles, erysipelas, surgical conditions of the abdomen, aspirin poisoning, peliosis, rheumatics, and exfoliative dermatitis.

We have made an attempt roughly to classify the types of cases seen in the Border Cities. All told, we had in the Border Cities thirty-four cases of smallpox. Eight of these were in persons who had been vaccinated years before, and all of these cases were perfectly clear cases of smallpox. Six cases were vaccinated during their incubation period, and came down with smallpox and a taking vaccination. All of these were also perfectly plain cases of smallpox, offering no difficulties in diagnosis. Twenty-one cases had never been successfully vaccinated at any time in their lives, and of these no less than eleven were irregular in type. Of the eleven distinctly irregular cases one had a rash which might be described as hæmorrhagic urticaria, six had lobster rashes more or less complete, one had lobster rash on the face and a measles-like rash on the body, three had a flushed face and a smallpox rash which came out late and badly. It is to be noted that not one case presenting the features of irregularity that have been described recovered from the disease.

Cases of Smallpox without a Rash.—Not included in any of our figures as actual smallpox were eight cases in the Border Cities and three at Amherstburg presenting the following features. They were all persons vaccinated before and having good scars 10 years or more old. They came down ill with the usual symptoms of smallpox—fever, headache, backache, prostration, and so on. After an illness of three or four days they recovered completely without developing a rash. We are inclined to the opinion that those cases were infectious on account of their illness, but the evidence is not conclusive.

Methods of Transmission.—Smallpox is usually transmitted by at least a fairly intimate contact with a case and aerial infection, fomites; third person carriers and cases having symptoms but no rash play a relatively small part in transmission. In our epidemic these unusual methods of transmission played a very considerable part. Out of a total of sixty-seven cases these unusual methods of transmission apparently operated in no less than twenty-nine.

Measures adopted to Control the Epidemic.—When the epidemic first broke out there was a period of two or three days in which we were not certain that we were really dealing with an outbreak of smallpox. The cases were irregular, and it was only after we had seen two or three typical cases that we were sure what we were dealing with. While certain preliminary steps had been taken two or three days before, it was on Saturday night, February 23, that the Board of Health met to determine what measures should be taken to check the epidemic. By that time we knew that the disease we were dealing with was smallpox, that the community was seeded with cases, and that it was an exceedingly virulent and irregular form of the disease. The Local Board of Health for the Essex Border Municipalities has a distinctly unusual composition. The Board has jurisdiction over six municipalities, and every member of the Board is a doctor who has at some time been a Medical Officer of Health himself. The measures decided upon by the Board were as follows: Provision was made for the care of the sick and the maintenance and medical supervision of families in quarantine, but the most vital decision of the Board was in respect to vaccination. The Board was a unit in the opinion that the one thing that would stop the epidemic was vaccination of the whole population. Our population is about 70,000 persons, and the problem before the Board was to get that population vaccinated in the shortest possible period of time. The procedure decided on was as follows: Then and there three of our nurses using three phone lines called up every doctor in the border cities that could be reached and asked him if in the emergency he would consent to vaccinate, free of charge, any person who came to his office, it being understood that the Board of Health would supply vaccine and pay for vaccinations at the rate of twenty-five cents apiece. Within half-an-hour we had the consent of about three-quarters of our doctors. The rest could not be reached, but we assumed their consent and telephoned them Sunday morning. Before midnight a statement of the situation was prepared and sent out to every clergyman in the Border Cities, with a request that it be read from the pulpit at every service on Sunday. The gist of the announcement was that an epidemic of exceedingly severe smallpox was present in the Border Cities, that there had already been a number of deaths, and that everyone was advised to be vaccinated at once and to have all the members of his household vaccinated; finally, that arrangements had been made with every doctor in the Border Cities under which he would vaccinate, free of charge, any one who came to his office. On Sunday, at our request, the Secretary of the Chamber of Commerce called up every large employer of labour in the Border Cities, explained the situation to him and asked him to urge vaccination upon all his employees on Monday morning. Monday afternoon a full page advertisement of the Board of Health setting forth the situation appeared in the local paper.

The effect of these measures was all that we could have asked for. There are some seventy doctors in the Border Cities and we had simply created

seventy free vaccination stations. The doctors' offices began to be crowded with applicants for vaccination on Sunday morning and within the next six days we estimate that well over ninety-five per cent of our population was vaccinated. There was nothing compulsory about any of our methods. We simply took the public into our confidence, told them the situation as it really was, advised general vaccination, and made provision for it without charge. The anti-vaccinationist, usually so noisy and troublesome, gave us no trouble at all. As far as checking the epidemic was concerned the effect of these measures was 100 per cent perfect. We had one big splash of cases and then silence, and that silence has continued without interruption right up to the present moment—almost three months.

Vaccination.—The total figures for the whole epidemic covering the Border Cities, Amherstburg, Maidstone and Detroit, are as follows :—

	Cases	Deaths	Mortality
Never successfully vaccinated	45	32	71 per cent
Vaccinated successfully twelve to sixty-five years before	10	0	0
Vaccinated successfully in incubation period, i.e., came down ill with smallpox and a taking vaccination	12	0	0
Totals	67	32	48 per cent

You will note that no person who had ever been vaccinated successfully at any time in his or her life, whether it was in the incubation period of smallpox or years and years before, died of smallpox. You will note also that of the persons who had never been successfully vaccinated and who developed smallpox seventy-one per cent died of the disease. That is a wonderful story in regard to the efficacy of vaccination as mitigating the severity of the disease, but the figures by no means tell the whole story.

A few persons who had never been successfully vaccinated recovered, but they all had severe attacks and had a terrible fight for their lives.

On the other hand, persons who had been previously vaccinated successfully, no matter how long before, had mild attacks. Incidentally it should be mentioned that no one vaccinated successfully within twelve years took smallpox at all. But the real marvels of vaccination can, in my opinion, be appreciated only by personal experience in an epidemic such as we went through in the Border Cities. I feel that I might very well close this paper by telling you of some of our actual experiences.

In Windsor there is a family named M——, consisting of ten persons. All of them were exposed to smallpox and about equally. Nine of them had been vaccinated successfully in previous years, and none of these contracted smallpox. The tenth person had never been vaccinated, contracted the disease and died inside of four days of the hæmorrhagic lobster rash type of smallpox.

During the epidemic we had to employ a large number of nurses to look after the sick, and we had also to expose to the disease orderlies, ambulance drivers, clergymen and others. We made it an absolute rule that no one should be exposed to smallpox through our action unless that person had a vaccination scar already, and was also freshly vaccinated by us. The

result of this precaution was that not a single person who was exposed to the disease through any action on our part came down with smallpox.

Of course, when a case of smallpox developed in a household we vaccinated every other person in the house. Contacts of this kind which in Maidstone, Amberstburg and the Border Cities run into the hundreds, all, as far as I know, escaped smallpox as a consequence of timely vaccination.

In Windsor a certain Mrs. McL., 62 years of age, never vaccinated, developed smallpox and died of it. Her husband, 72 years of age, vaccinated successfully sixty-two years ago, had a trifling attack of the disease.

Mrs. J. D., of Walkerville, 52 years of age, never vaccinated, developed smallpox and died after an illness of eight days. Her husband with a history of exposure many times in excess of that of his wife, had a trifling attack of smallpox. He had been successfully vaccinated twelve years ago.

The proprietor of a laundry came down sick with smallpox, and on investigation it was found that out of a total staff of twenty-five persons at the laundry he alone was unvaccinated, and he was the only one who contracted the disease.

A. D., aged 50, and his son, R. D., aged 25, neither having been successfully vaccinated, died of smallpox. Mrs. A. D., vaccinated successfully thirty-two years before, took smallpox also, but it was a trifling illness.

Mrs. B., of Windsor, came down with a mild attack of smallpox. She is 58 years old. When she was 8 years old she went into a convent for three years, and in the first of those years she was vaccinated successfully. As a result of that vaccination fifty years ago her attack of smallpox was a negligible affair. The scar on her arm is so faint that it can be recognized only by careful search in a good light.

G. D., the man who had the original illness that was smallpox but was not diagnosed as such, had a daughter. Josephine, aged 12. She was exposed to her father through the whole course of sickness and later on to her mother and aunt who developed smallpox *but she has not had one single day's illness herself.* Six years ago she was vaccinated to go to school and she has on her left arm a scar about the size of an old-fashioned Canadian five cent piece. Twenty-one close relatives of this little girl, all unvaccinated, are dead of smallpox.

It is when one has had close personal experience with incidents such as these, when one had to send nurses by the dozen up against the most virulent smallpox, with nothing to protect them except vaccination, and they nurse the disease week in and week out without contracting it; when onehas seen a community of thousands of persons threatened with decimation by smallpox and one has seen wholesale vaccination pull the disease up short and weeks and weeks go by without any fresh cases at all, then and only then does one fully appreciate the marvellous gift which Jenner made to science and to humanity.

Lessons to be learned from the Epidemic.

(1) Exceedingly virulent smallpox is present in the province.

(2) Irregular forms of the disease, presenting great difficulties in diagnosis, are apt to occur.

(3) The disease may be transmitted through unusual channels and quarantine of cases and all contacts should be very rigid.

(4) Vaccination is the one sure weapon against the disease.

In this epidemic:—

(*a*) No one vaccinated successfully within twelve years contracted smallpox.

(*b*) No one ever vaccinated successfully, no matter how long ago, died of smallpox.

(*c*) Of the smallpox cases in persons who have never been successfully vaccinated seventy-one per cent died.

(*d*) Vaccination of almost the whole population stopped the epidemic abruptly and completely.

The Composition of Beef and Malt Wine. By G. D. Elsdon, B.Sc., F.I.C. *Analyst*, xlix, 210.—Details of the analysis of a sample of spurious beef and malt wine are given, and the question of the standardization of medicated wines is discussed. A suggestion is put forward that "a beef and malt wine should be prepared by the addition of at least 2½ per cent of beef extract and 2½ per cent of malt extract." The composition of such a wine made up with a cheap Spanish or Portuguese wine would approximate to 0·18 per cent of nitrogen and 0·12 per cent of phosphorus pentoxide. Analyses of various medicated wines are given in the paper, together with a quotation from Hutchison's "Food and the Principles of Dietetics," as follows:—

"It is far cheaper and also better for an invalid to get beef or malt extract separately and take along with them, if need be, a definite quantity of sound wine of known antecedents.

"In the second place, it is open to grave question whether the ferment of malt (diastase) is not much impaired by the action of the alcohol to which it is exposed when dissolved in a fortified wine, such as port or sherry."

S. E.

Tests for the Purity of Carbon Tetrachloride.—Major Clive Newcomb, I.M.S. *Analyst*, xlix, 225. Carbon tetrachloride is used in the treatment of hook worm disease and reports are in existence showing that impure specimens of this drug give rise to serious symptoms. In order to ensure more purity in the specimens, the following tests are suggested:—

Specific gravity, presence of phosgene, carbon bisulphide, sulphur chloride, aldehydes and other oxidizable substances and organic impurities. The hope is expressed that other analysts will come forward with suggestions for tests. Details of above tests are given in the note.

S. E.

A Note on "The Detection of Persulphate in Flour and a Recent Bleaching Agent for Flour." Read by Mr. J. Miller, F.I.C., at the Manchester Section, Soc. Chem. Ind., *Chemistry and Industry*, vol. xliii, No. 19, p. 484.—The reagent generally used for the detection of "persalts" in flour is an alcoholic solution of benzidine, but potassium iodide was suggested as a substitute. A new bleaching agent for flour is termed "Novadelox B" and contains benzoyl peroxide as bleaching agent and acid calcium phosphate. Flour bleached with this substance, made into a paste with potassium iodide solution and heated on a boiling water bath, develops dark spots. S. E.

Some Observations upon Yellow Fever Prophylaxis. By Aristides Agramonte, M.D., Professor of Bacteriology, University of Havana, *Journal of Tropical Medicine and Hygiene*, No. 21, vol. xxvii.—In this comprehensive paper, which should be consulted in the original by all who have to deal with the problem of yellow fever, the author reminds his readers that the last word on the prevention and control of yellow fever has not yet been said, and cannot be given until the etiology of the disease has been clearly and definitely settled.

Since 1881, when Findlay, by a brilliant conception, indicated the mosquito as the vector of yellow fever, twenty years elapsed before his theory was accepted, because, with the technical resources at his disposal, he could not prove it.

It remained for the United States Army Board, working in 1901, under Sternberg and Reed, to sift out erroneous methods and deductions, and to direct the investigations that finally brought Findlay's theory to conclusive proof and enabled the Board to outline sound methods for combating the disease. Although the subsequent campaigns against this disease have been attended with admirable results, yellow fever still retains its hold on certain parts of Brazil, Mexico, on the West Coast of Africa and in San Salvador.

The author believes that the rôle which children play in maintaining epidemic conditions in these localities has been somewhat neglected by sanitarians, and in order to account for epidemics of yellow fever in certain places, which for months or years have been free of infection, we must look for a latent source of the disease in children. He therefore stresses the necessity for a careful investigation of cases in children of so-called gastric or bilious fever which, he says, will usually co-exist with neglect of sanitary ordinances regarding mosquitoes and their breeding places.

The known facts regarding the etiology of yellow fever are summarized as follows:—

(1) The parasite is one that requires the mosquito as intermediate host and vector.

(2) The parasite is present in the peripheral blood only during a definite period of the disease (the first three or four days).

(3) A definite period (twelve days) must elapse before the mosquito is

capable of transmitting the parasite in condition to reproduce the disease in man.

(4) There is a period of incubation, not greater than six days, before the appearance of the first symptoms.

Any prophylactic measures that are not based upon and controlled by these four points are dangerous. In this category the so-called protective vaccination is placed, because its practice implies an immunity, the existence of which is doubtful; moreover, its value cannot be fairly demonstrated when selected bodies of soldiers are used for the purpose and the general population, who may be living under less sanitary conditions, are excluded.

The protective vaccine now used for yellow fever is said to be obtained from animals inoculated with *Leptospira icteroides* of Noguchi.[1]

In the author's opinion this leptospira, pathogenic to dogs and guinea-pigs, and presented as the cause of yellow fever in man, fails to fit in with such etiological facts as we know relate to the human diesase.

It is not considered sufficient to have demonstrated the leptospira in a certain number of guinea-pigs inoculated with blood from cases of yellow fever, when other observers have repeatedly failed to obtain confirmatory results. Neither is it fair to attribute failure on the part of the so-called "negative" investigators to faults in their technique.

The author is therefore sceptical as to what *Leptospira icteroides* really represents in the cases where it was found by its discoverer, though he does not doubt that the diagnosis of yellow fever in these cases was correct.

In support of his attitude towards the problem, he claims that:—

(1) The serological differences between *L. icteroides* and *icterohæmorrhagiæ* are not pronounced, and, in fact, are now greater than those we find between different strains of other organisms that may be classified in a single group. Yellow fever and Weil's disease are pathologically entirely distinct.

(2) If the leptospira were really the causative germ we have good reason to believe that it must undergo some kind of evolution in the mosquito's tissue, analogous to that of the malarial parasite in anophelinæ —but so far no one appears to have succeeded in demonstrating any process of development of the *L. icteroides* in *Ædes egypti.* We know, in fact, that no change takes place, and that the mosquito soon expels the leptospira just as it took it from the capillaries of the guinea-pig.

(3) The symptoms, the pathological and histological lesions and the hæmolytic conditions which *L. icteroides* causes in animals are very closely

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[1] A vaccine prepared with killed cultures of *L. icteroides* grown in semi-solid medium, viz., Ringer's solution + human serum + agar was also used, and the serum of patients who had recovered from yellow fever was found to have both preventive and curative properties.

related, if not identical, with those caused by *L. icterohæmorrhagiæ*, the etiological factor in Weil's disease.

It is argued, therefore, that the specificity of *L. icteroides* in yellow fever has not been proved, and that its presence in cases of yellow fever is explained on the hypothesis that it is merely a symbion, though it may have some part to play in the induction of the hæmorrhagic phase of the disease. If, however, *L. icteroides* is accepted as the cause of yellow fever it will be necessary to modify some of our views regarding the epidemiology of the disease. The author criticizes the use of so-called prophylactic vaccines and curative serum derived from *L. icteroides*.

He points out that so long as experiments and tests with this microbe are restricted to the lower animals, and the value of the vaccine and sera in yellow fever is determined only from animal experiments, *L. icteroides* can have only a laboratory interest. Not until it is proved that a mosquito infected from a laboratory animal can, after an interval of twelve days, infect a non-immune individual from whom all other sources of infection have been excluded can the specific character of Noguchi's germ be accepted, and he believes that the crucial experiment could be carried out without risk of death provided the subjects of the experiment were wisely selected and carefully tended should they become infected ; and in support of this opinion he quotes the experiment of United States Army Board, who had no fatalities in a series of eighteen cases which served to demonstrate the theory of mosquito transmission.

In conclusion, he states that the existing measures of quarantine, based on a six-day period of incubation as determined by applying infected mosquitoes to volunteers and by inoculating them with infected blood and serum have proved absolutely reliable in all affected parts of the Western Hemisphere. He deprecates any attempt to alter this estimate of the incubation period, because of results of experiments carried out on animals, and he warns sanitarians that they should not place too much reliance on vaccines and sera or other uncertain measures, but keep to the path hitherto followed by the pioneers in yellow fever prophylaxis and not weaken the fundamental structure of anti-mosquito campaign.

A further article entitled "Histopathology and Hæmatology of Yellow Fever," by Henry R. Müller, of the Rockefeller Institute, appears in No. 28 of the above-mentioned journal.

The paper gives a detailed account of histopathological changes induced in the viscera of guinea-pigs, dogs and monkeys by inoculating them with cultures of *L. icteroides*. It was found that the resulting histological changes are similar to those observed in human yellow fever. Hæmatological studies of the infected animals are also recorded, and the findings resemble those of yellow fever in man. In guinea-pigs there is a persistent leucopenia of moderate degree during the more severe infections. There is no change in the number of red cells and the hæmoglobin generally remains normal.

A. E. H.

Reviews.

THE DOCTOR'S OATH. By W. H. S. Jones, M.A. Cambridge University Press. 1924. Pp. 62. Price 7s. 6d. net.

This well-printed and interesting monograph, an essay on the history of medicine, has been prepared by collating more than thirty manuscripts. Mr. Jones gives the earliest forms of the Hippocratic Oath, of which there are two versions, the Pagan and the Christian. As the Hippocratic writings were textbooks that specialized in retaining the general sense of the teachings, often at the expense of literary accuracy, the document underwent much alteration, especially with regard to the Christian version. In the book are two facsimiles of the Christian oath. Existing manuscripts of the oath are discussed and translations of the two main versions, with some of the variants, are given. The book is a valuable monograph on a historical aspect of medicine upon which the ethical rules of the profession are based. M. B. H. R.

SIMPLIFIED ORGANIZATION AND ADMINISTRATION, WITH DIAGRAMS. By Captain R. H. D. Bolton, The Duke of Wellington's Regiment. Aldershot: Gale and Polden, Ltd. Pp. 168. Price 4s. 6d.

This would appear to be a very useful book for officers first commissioned in the Royal Army Medical Corps. It contains a fund of useful information which will enable an officer to quickly get an elementary insight into the general organization and administration of the British Army. While the author appears to be up-to-date, even to the extent of including the newly-formed Supplementary Reserve, Chapter XVII, "Medical Arrangements," is not up to the standard of the rest of the book, and we recommend officers who wish to have authoritative information on the organization of the Army Medical Services to consult other literàture. A few of the most conspicuous errors are quoted.

(1) *Organization of Medical Services.*—The author refers to a subdivision of these into Army Medical Staff, R.A.M.C., and H.D. Corps. The Army Medical Staff, he states, consists of officers above the rank of Lieutenant-Colonel. This is no longer the case—the Army Medical Staff does not exist, Major-Generals and Colonels being now designated Major-General or Colonel X, late R.A.M.C.

(2) B. Peace Time: The term *regimental hospital* is used instead of medical inspection room, and is a misleading term.

(3) D. Evacuation of Wounded: This is given in diagrammatic form and is out of date, such units being shown as stationary hospitals of 400 beds and general hospitals of 1,040 beds, motor ambulance convoy of 50 cars, field ambulances with bearer and tent subdivisions—regimental stretcher bearers numbering 16.

Chapter XIII "Furlough."—The note in para. 11 implies that a soldier

on furlough who requires medical aid is given the choice of reporting sick to the nearest military hospital or calling in a civilian doctor. This paragraph requires amplification that the latter procedure is only in cases where a military medical officer is not available.

Chapter V.—We note that the terms of enlistment for the Royal Army Medical Corps are shown as seven years with the colours and five with the reserve. This should be amended to three years with the colours and nine with the reserve. O. W. McS.

ESSAYS AND ADDRESSES ON DIGESTIVE AND NERVOUS DISEASES AND ON ADDISON'S ANÆMIA AND ASTHMA. By Arthur F. Hurst, M.A., M.D., F.R.C.P. London: William Heinemann (Medical Books), Ltd. Pp. vi + 306. Price 21s.

These essays and addresses, reprints of papers published in various medical journals, revised, expanded and brought up to date, record the author's present views on the various subjects in which he has been specially interested during the last ten years. He is an extreme modernist who steadfastly refuses to leave a question as settled and is always ready to modify the strongest of opinions in the light of further evidence. By this spirit of progress, combined with a high literary standard and flashes of humour, the essays are lighted up, so that subjects which might incline to dullness, when handled in a less masterly fashion, are presented to the reader in a form that is both attractive and engaging.

The essays are eleven in number, ranging over a wide field of subjects, from nervous disorders of the stomach to asthma; from achalasia to the sins and sorrows of the colon. In a short review it is not possible to go into details of the subjects that are dealt with so fully in this interesting book, which is interspersed with diagrams and plates, save to comment on the advanced teaching that every essay contains. One notes with interest the author's views on the importance of X-rays in the diagnosis of chronic appendicitis, and his intense dislike of purgatives: "If all the fortunes made from purgative pills had been devoted to the institutions which treat the victims of their abuse, the financial problem of the voluntary hospitals would have been solved. About £10,000,000 were expended in 1921 on patent medicines, the majority of which contain purgatives." The book is a valuable contribution to medical literature. M. B. H. R.

MODERN VIEWS ON THE TOXÆMIAS OF PREGNANCY. By O. L. V. de Wesselow, M.B., F.R.C.P., and J. M. Wyatt, M.B., F.R.C.P. London: Constable and Co., Ltd. Pp. vii + 99. Price 7s. 6d.

The third of the series of Modern Medical Monographs edited by Professor Hugh Maclean, M.D., D.Sc., this book forms a summary of our present-day knowledge of a subject which is stated to be one of the most obscure fields of medicine. The joint authors admit that the findings up to date are largely negative, and that their conclusions, to some extent provisional, may, with increasing knowledge, require revision; even so,

they have succeeded in presenting to the reader, in ninety-six pages, a reasoned appreciation of the position that the subject occupies to-day. The etiology of the toxæmias, the theories advanced as to source and nature of the toxins assumed to be concerned, the methods of investigation, the physiology of normal pregnancy, eclampsia and its treatment, are some of the subjects that are dealt with fully in this book, which is replete with modern views and recent progress. M. B. H. R.

Modern Methods in the Diagnosis and Treatment of Pulmonary Tuberculosis. By R. C. Wingfield, M.B., M.R.C.P. London: Constable and Co., Ltd. Pp. xi + 134. Price 10s. 6d.

This book is the second of the series of modern medical monographs, edited by Professor Hugh Maclean, M.D., D.Sc. It is intended as a short review of present-day methods of diagnosing and treating pulmonary tuberculosis, for the use of the senior student and the general practitioner. In 130 pages, illustrated by twenty-seven diagrams and plates, the author covers the wide subject in a manner that is remarkably readable and easily assimilated. He insists on the importance of first obtaining a clear conception of the disease, and demonstrates that pulmonary tuberculosis plays little part in the huge infantile mortality from all kinds of tuberculosis; it is not until the ages of fifteen to twenty that the pulmonary form of the disease becomes an important cause of death, the hypothesis being that pulmonary tuberculosis is a re-infection rather than a spread from childhood infection. Whether correct or not, the author considers that modern methods of treatment and diagnosis should be based upon this.

An interesting chapter is that on the after-care of the chronic, the quiescent, or arrested case, which he ranks next in importance to early diagnosis in relation to the ultimate result. As regards the case who has to earn his living, the author does not approve of agricultural work—ill-paid, long hours, "Nature which controls the time and severity of the task is a harder master than any man." Among the factors of success in treatment is the point that a cure is most likely to be obtained if the possibility that it has been obtained is never admitted.

Dr. Wingfield has written a first-class treatise on the diagnosis and treatment of pulmonary tuberculosis which will find a wide circulation.

M. B. H. R.

Recent Methods in the Diagnosis and Treatment of Syphilis. By Carl H. Browning, M.D., D.P.H., and Ivy Mackenzie, M.A., B.Sc., M.D. London: Constable and Co., Ltd. 1924. Pp. xxii + 537, Second edition. Price 42s.

The contents of this volume are essentially a record of original work, some of which has already been recorded in various journals, but many observations are published for the first time.

The work is divided into two parts. Part I deals with Diagnosis; Part II with Treatment.

Nineteen chapters are devoted to diagnosis, and the ground is systematically and exhaustively covered from the demonstration of the *spirochæta pallida* to the latest theory of the syphilitic serum reactions.

The literature dealing with these subjects has reached enormous proportions in the last ten years, but the reader will find that the authors have successfully collected all the relevant material, discussed every aspect of the subject, and presented the information in a very readable form. At the end of each chapter there is a very useful and complete list of references.

The contents of these chapters on diagnosis are of necessity highly technical and of extreme importance to those working on this subject and treating syphilis, but may dip too deeply for the busy practitioner; however, the chapters dealing with the clinical application of the syphilis serum reaction should appeal to every branch of the profession, and are the most complete, exhaustive and up-to-date exposition of this important subject yet published.

We thoroughly agree with and wish to emphasize one of the authors' conclusions, that "every patient should have the syphilis test applied to the serum as a routine in view of the prevalence of syphilis, and of the great variety of obscure manifestations of disease which may be caused by syphilis, and which may be influenced favourably by anti-syphilitic treatment."

The chapter on the cerebro-spinal fluid is by J. Cruickshank. It is up-to-date and complete.

Part II. Treatment, by I. Mackenzie, is dealt with in seven chapters. The subject is treated on general and novel lines. It is no mere enumeration of rule-of-thumb methods, but a successful attempt to demonstrate the scientific principles which govern the modern treatment of syphilis, controlled by a wide experience of cases and experimental data in animals.

This volume is likely to be very popular with all responsible for the treating of syphilis who require a reliable book of reference for laboratory and clinical methods and an authoritative exposition of the whole subject.

There is an instructive introduction by Professor Muir, of Glasgow, and the letterpress is reinforced by five plates, two of which are coloured.

THE NERVOUS PATIENT. By Dr. Millais Culpin. London: H. K. Lewis and Co., Ltd. 1924. Pp. viii + 305. Price 10s. 6d.

"The Nervous Patient," by Dr. Millais Culpin contains a chapter on Eye Symptoms by Dr. W. S. Inman and a chapter on the Major Psychoses by Dr. Stanford Read.

Dr. Culpin has written this book especially for the general practitioner, and he shows that the very numerous symptoms, which he includes in the term "The Nervous Patient," can be alleviated, if not cured, by a knowledge of psycho-pathology.

From the point of view of the medical practitioner in particular, but

also from that of the specialist, there is often great difficulty in deciding whether a patient is suffering from a minor psychosis—so called by Dr. Culpin—or a major psychosis.

This difficulty is rendered less acute by a careful study of the book, but it always exists, as the difference between the two is only a question of degree. The book contains a great deal of useful information, and is illustrated by many cases.

It is a happy idea to include in such a book a chapter on Major Psychoses, by Dr. Stanford Read; this must increase the value of the book considerably from a practical point of view.

W. L. W.

Annals of the "Pickett-Thomson" Research Laboratory, Vol I. July, 1924. No. 1. President: Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S. Honorary Director and Editor: D. Thomson, O.B.E., M.B., Ch.B.(Edin.), D.P.H.(Camb.). Pathologist and Assistant Editor: R. Thomson, M.B., Ch.B.(Edin.) Issued by the "Pickett-Thomson" Research Laboratory, St. Paul's Hospital, 24, Endell Street, London, W.C. 2. Price 25s. net.

This is a series of collected papers recording research work carried out in the laboratory by the director and others.

The chief contribution is a series of papers on Researches on the Virus of Variola Vaccinia and the Etiology of Measles and of Scarlet Fever; the main part of these papers consists of a most complete résumé of the literature already published on these subjects.

The papers are arranged under the following headings:—

(1) Is the cause of variola vaccinia a germ or bacterium?

(2) Is it a filter passer?

(3) Is it a protozoan?

The résumé of the literature is an exceedingly comprehensive one and is well worth perusal by any one who proposes to engage in research into the causes of these common diseases, although much that is recorded therein is now only of historical interest.

The results of the author's own attempts at cultivation of the virus of vaccinia on a wide range of media are detailed. He arrived at the conclusion, supported by experimental work, that none of the various bacteria cultivated from lymph could be the active agent of vaccinia. The experiments were repeated with specially prepared active bacteria-free vaccine lymph, also with negative results.

Some experiments designed to show that the agent of vaccinia is non-filtrable are given at some length.

Undiluted non-glycerinated lymph was used; 150 cubic centimetres of this was ground into a fine paste and thoroughly shaken and then centrifuged—the sediment being discarded and the supernatant milky fluid used for the test.

Two rabbits inoculated with material from the first grinding gave

positive results as did two more with material from the second grinding; two rabbits inoculated from the sediment gave positive results as did three inoculated with the milky fluid before filtration and two inoculated from scrapings from the filter candle.

Thirteen rabbits inoculated with the filtrate coming from the Berkefeld filter gave completely negative results, both in the cornea and on the skin.

As the author says :—

"The above therefore constitutes an extraordinarily clear cut and convincing experiment, a total of twenty inoculations with vaccine lymph previous to filtration gave 100 per cent positive results, whereas a total of twenty-six inoculations with the filtrate from a Berkefeld filter gave 100 per cent of completely negative results."

In discussing the contradictory results obtained by various workers on the question of filterability or non-filterability of this and other so-called filter-passing organisms, the author emphasizes the necessity of thorough testing of candles before experiment; the test he recommends is to place the candle under water and blow air through it, a sound candle will show an even efflorescence of small bubbles of air whereas if there are any faults they will be disclosed by a stream of large air bubbles. Where such large air bubbles can emerge, small bacteria and even red cells may be passed through the cracks and holes.

As regards the protozoal nature of the virus of vaccinia the author gives a very full and thorough résumé of all that has been written on the subject so far as his own work goes, he states that his conclusions are that the virus of vaccinia cannot be an ordinary bacterium as it cannot be cultivated, that it is not a filter-passer; but he is inclined to the opinion that the Guarnieri bodies are true parasites.

Two well reproduced coloured plates and some good photomicrographs are appended. The coloured plates show various cell inclusions which in the opinion of the author are extraordinarily like protozoa.

The next paper, the Etiology of Measles, follows much the same lines as that dealing with vaccinia; a very exhaustive summary of the literature is followed by a brief account of the researches of the author.

Various theories are discussed—is the virus of measles a bacterium, a spirochæte, or a fifter-passer? He describes a minute Gram negative anærobic diplococcus which was isolated from the throats of measles patients and states that Professor Caronia has also isolated a similar organism from such cases.

In view of the fact that the author and Holman also have found this diplococcus to be present in normal throats he definitely states his opinion that it cannot be the cause of measles. He is of the same opinion in regard to the protozoan and spirochæte theories.

As regards scarlet fever a similar extensive summary is given of the many researches undertaken to discover the cause of this disease.

He dismisses the protozoan theory and discusses the recent work of

George Dick and Gladys Dick on the streptococcus isolated from cases of scarlet fever and the test they employ to show the presence of immunity or susceptibility to toxin of this germ.

The author agrees that evidence has accumulated in favour of the view that a definite variety of streptococcus is the primary cause of scarlet fever.

A short paper by Dr. Potts on treatment and prevention of oto-rhinological complications of scarlet fever by detoxicated vaccine follows; a mixed vaccine of a diphtheroid, staphylococcus and streptococcus was used.

Another paper gives some details of further work in the preparation of detoxicated vaccines.

The final conclusions are that when bacteria and their antigens are subjected to boiling and treatment with absolute alcohol their antigenic properties are destroyed.

When treated with alkalies their antigenic properties are weakened, but the weaker the alkali used the less is the deleterious effect produced.

Alkali in a strength of 1:20 to 1:100 normal would appear to have little or no injurious effect.

In view of the above, washing with alcohol has been abandoned and saline washing substituted, and only weak alkalies are now employed in the preparation of detoxicated vaccines.

An interesting paper is one by Dr. D. Bateman on the treatment of men who have been gassed while employed in factories in France where gas shells are broken up. T.N.T. poisoning was also met with; this was combated by putting the men on other work in the open air every alternate week.

The first gas to attract attention by its effects was SK-ethyl iodacetate. It produced lachrymation and conjunctivitis. One cause of poisoning by this gas was found to be that workmen in cold weather used to sleep fully clothed in the garments used while at work and with their heads covered by blankets. Under the action of heat the gas was eliminated from the clothes and the workmen woke up gassed. More than 150 cases of gassing by yperite were met with. Dry cupping and bleeding were used as methods of treatment. Burns caused by liquid yperite gave rise to ulcers which took a long time to heal. These were treated by washing and dressing with Dakin's solution.

Several deaths were due to the after-effects of phosgene gas. Bleeding in the initial stage of the poisoning was found efficacious in treatment, and inhalations of oxygen were also employed with success.

The whole volume is well got up, the print is large, and an excellent photograph of the President of the laboratories adorns the front page. Also some photographs of the interior of the laboratories are included, which show the entrance to the annexe and a portion of the central dome inscribed with the motto:—

> Tho' we may never reach the Peak,
> God gave the great commandment "Seek,"

taken from Sir Ronald Ross' poem "Vision."

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, a volume commencing on 1st July and 1st January of each year.

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Single copies can be obtained at the rate of 2s. per copy.

The Corps News Supplement is also issued separately from the Journal, and can be subscribed for at the rate of 4s. (four shillings) per annum, including postage. All subscriptions are payable in advance.

Subscriptions for the Corps News Supplement separate from the Journal cannot be accepted from Officers on the Active List unless they are also subscribing to the Journal.

Single copies can be obtained at the rate of 6d. per copy, excluding postage.

Cheques or Postal Orders for Subscriptions, etc., should be made payable to the "Hon. Manager, Journal R.A.M.C." and crossed "Holt & Co."

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Original Communications.

THE CLINICAL AND PATHOLOGICAL ASPECTS OF EPITHELIOMA ADENOIDES CYSTICUM.

By LIEUTENANT-COLONEL H. MARRIAN PERRY,
AND
TEMPORARY CAPTAIN F. CARMINOW DOBLE.
Royal Army Medical Corps.

THIS uncommon new growth of the skin is not frequently encountered, but we have recently had the opportunity of studying its clinical and pathological aspects in the case of a young airman admitted to the Queen Alexandra's Military Hospital, Millbank, and have thought it is of sufficient interest to be placed on record.

The patient is an air-craftsman, aged 25. He stated that growths commenced to appear on his face from two to three years ago in the form of small cutaneous nodules. The skin on either side of the bridge of his nose, and between his nose and eyes, was the part first affected. Later these cutaneous swellings appeared in the groove behind the alæ nasi, and still later on his temples, forehead and behind his ears, whilst a larger nodule than any noted on the face occurred in the skin between his shoulder-blades. Except for a few fresh nodules on his forehead the patient is of opinion that the condition has remained stationary for the past year. He volunteered the statement that he first noticed the lesions after he had commenced boxing. No history of any other member of his family being affected could be obtained in this case.

THE CLINICAL ASPECT OF THE CASE.

The unsightly appearance resulting from the condition was very evident when the patient came under observation. Pearly-white translucent nodules of a firm consistence were closely distributed over his forehead,

behind his ears and on either side of the alæ nasi, a few were present in the skin behind the neck, and one, the size of a hazel-nut, between his shoulder-blades. No nodules could be seen or felt in his scalp. The size of the nodules varied from that of a pin's head to that of a pea, with the exception of the much larger nodule in the skin of the back. In size, distribution and appearance they closely resembled colloid degeneration of the skin. On opening a nodule a little serous fluid and blood escaped, but no colloid secretion. The disfiguring nature of the disease is apparent in the illustration (fig. 1).

Diagnosis.—This case is not at all typical. In most of the cases previously described only a few nodules were present, but in this case there were at least 200. The pearly whiteness of the lesions and of the surrounding skin was in striking contrast to the usual appearance of this disease. As a rule the situation and persistence of the new growths, first appearing in childhood or puberty, and the history of the occurrence of the condition in other members of the same family, is helpful in making a clinical diagnosis.

The differential diagnosis is between adenoma sebaceum, syringo cystadenoma and molluscum contagiosum. In this case a clinical diagnosis was rendered impossible owing to the atypical nature of the lesions. The true nature of the case was not recognized until a nodule was excised and sectioned.

The earliest phase of the condition usually noted is the appearance of macules or papules with or without telangiectasis [1], [2]. In the case under consideration, if the patient's history is accurate, the growths commenced as small white nodules.

Ætiology.—The cause of this condition is as obscure as that of new growths in general. In most cases there is a well-marked hereditary predilection to the disease, and females are far more commonly affected than males. The process usually originates, as is noted above, in childhood or at the age of puberty.

Prognosis.—In the vast majority of cases the growths are benign, as is referred to in the pathological consideration of the condition, and if thoroughly treated they do not tend to recur.

Treatment.—The usual line of treatment recommended is curetting followed by cauterization with acid nitrate of mercury, or a course of radiotherapy or radium. Owing to the multiplicity of nodules in this case surgical diathermy has been advocated

The Pathology of the Lesions.

The name which has been given to this nodular development of the skin—*epithelioma adenoides cysticum*—is misleading, unless it is recognized that the term epithelioma is employed in its wider sense as indicating a new growth arising from epithelium, and not a malignant

FIG. 1.

To illustrate "The Clinical and Pathological Aspects of Epithelioma Adenoides Cysticum," by Lieutenant-Colonel H. MARRIAN PERRY and Temporary Captain F. CARMINOW DOBLE.

FIG. 2.—Proliferation of basal epithelium of epidermis. Many small hyaline areas are noticeable in the processes of epithelium.

FIG. 3.—Solid alveolar formation of the epithelium in corium enclosed in connective tissue capsule and illustrating rudimentary development of cyst.

FIG. 4.—Typical cystic formation with well marked development of hyaline material.

To illustrate "The Clinical and Pathological Aspects of Epithelioma Adenoides Cysticum," by Lieutenant-Colonel H. MARRIAN PERRY and Temporary Captain F. CARMINOW DOBLE.

proliferation of this tissue. The neoplastic process is not of malignant nature, and though a few cases have been placed on record which later in the history of the case have undergone this change, this sequence of events is uncommon. The epithelial overgrowth is essentially innocent, does not give rise to secondary deposits and is of marked chronicity in its course and duration.

The tissue of origin of the new growth is the basal epithelium, and as these cells form the deeper layers of the epidermis and the root sheath of the hair follicles, evidence of their proliferation is found in these situations. In the more superficial lesions the overgrowth, arising from the epidermis, occurs as finger-like processes, or irregular columns of varying size, of epithelial cells which extend into the deeper tissues and which are surrounded by a connective tissue stroma rather more dense than that of the corium. The more external cells of these epithelial processes are arranged in a very definite palisade pattern, and in the depth of this tissue evidence of commencing hyaline change may be seen in the occurrence of small translucent areas (fig. 2).

In the deeper lesions, originating from the hair follicles, the epithelial multiplication is adenoid in character, and occurs either as solid alveoli, circular in shape, the external layer of cells having a palisade arrangement and being circumscribed by a firm connective tissue (fig. 3), or as cystic spaces containing a structureless hyaline material (fig. 4).

The cystic areas are particularly characteristic of the histology of the condition. At their inception they appear, as noted above, as little translucent points in the masses of epithelium. They originate from cells of the follicle from which the hair is normally developed. In shape, they are either circular or slightly oval, and may be seen in all stages of their formation. In some cysts the surrounding layer of epithelium is of considerable thickness, in others the hyaline formation has progressed to such an extent that the merest trace of epithelium remains at the periphery. The size of the skin nodule bears no relation to the extent to which this development has progressed, some of the smallest nodules contain the largest cysts, whilst many of the larger nodules show nothing more than a very rudimentary formation of these hyaline spaces. In one of the largest nodules seen in this case which occurred in the skin of the middle line of the back cystic development was entirely absent.

In one account of the pathological changes associated with this condition it is stated that certain of these alveolar collections of cells may show evidence of an attempt at the formation of sebaceous glands which is assumed to be an indication on the part of the growth to reproduce the pilo-sebaceous apparatus. No indication of such development, however, is demonstrable in any of the sections made from this case. The presence of some small granules of pigment has been noted in the inner layer of cells of many of the cysts and these can be referred to effort on the part of this epithelium to form hair which is its normal physiological function.

This peculiar epithelial overgrowth was, when first recognized, interpreted as an adenoma of sebaceous glands, and was also described as originating from the duct of sweat glands, but was differentiated from these conditions by the histological investigations of Brooke [1]. An interesting series of cases has been recently recorded by Savatard [4] in which the clinical and pathological aspects of the skin lesions is well illustrated.

REFERENCES.

[1] Brooke, *British Journ. of Dermatology*, 1892, iv, pp. 269-286.
[2] Sutton, *Journ. of Cutaneous Diseases*, 1911, vol. xxix, p. 480.
[3] Ewing, "Neoplastic Diseases," 1922, p. 835.
[4] Savatard, *Proc. Roy. Soc. Med.*, 1923, vol. xvi, No. 3, p. 30.

A COMMAND STAFF EXERCISE.

By Major W. EGAN, D.S.O.
Royal Army Medical Corps.

The Scottish Command held a Staff Exercise on June 10, 11 and 12 of last year, in which all branches of the Army were represented, and the following notes on that exercise are written in the hope that the experiences gained may be of use to brother officers who may have to take part in a similar exercise, and to those Majors who have yet to jump the last fence in their examination race.

As far as the Corps is concerned, we were fortunate in being able to secure the attendance of the two officers who command the Field Ambulances of the Territorial Divisions in this Command. This it is believed is a new departure. In addition to these, four Regular Officers attended, as well as two on the directing Staff, of whom the writer was one. It was hoped to secure more Regular Officers, but in a Command like this where officers are few and very far between, this was found impossible.

The scheme is not based on any campaign, or part of a campaign, during the late or recent wars, but was designed to meet the local conditions; consequently, from a medical point of view, it was extremely interesting, especially when writing the medical appreciation of the situation. In the scheme one had to visualize the local possibilities and their relation to the causation of disease and their effects on battle casualties.

Object of the Exercise.

The object of the exercise is briefly summarized as follows :—

(1) To bring out the necessity for rapid issue of orders and instructions in a war of movement.

(2) To show that when few roads are available special forethought is required to ensure that the order of march of units is in accordance with probable tactical requirements.

(3) To study advanced guard action and show in conjunction with (2) above that considerable time must elapse before intervention by the main body becomes possible.

(4) To study the operation and effect of the rearward services of the Corps and Division in mobile warfare.

(5) To study the advantages of the mechanicalization of the D.A.C. and Divisional Train, together with the limitations imposed by lack of sufficient roads.

(6) To consider the positions and movements of the Headquarters of formations during mobile warfare.

Maps.

Reference Map, O.S. Scotland. Sheets 33 *and* 34. *One inch to one mile.*

General Idea.

(1) Southland, capital Newcastle, comprises the six northern counties of England, together with the counties of Berwick and Roxburgh.

Northland, capital Edinburgh, comprises the remainder of Scotland. These are two independent states.

The frontier between Northland and Southland is shown in red on one-inch map, Sheet 33, issued with the scheme.

Northland is an agricultural country and has no big towns except Edinburgh and Aberdeen.

Southland mainly agricultural, but has important industrial centres round Manchester.

The only railways in existence are :—

York — Newcastle — Berwick — Edinburgh double, with single line branches to Eyemouth and Haddington.

Edinburgh—St. Boswells, double.

St. Boswells—Reston, single.

Edinburgh—Stirling—Aberdeen
Edinburgh—Glasgow—via Falkirk } Double.
Tweedmouth—Kelso—St. Boswells

(2) Southland commenced mobilization on May 25 and declared war on June 2. Its mobilization was complete midnight June 7/8.

(3) The armies of Northland and Southland are shown in Schedule B.

(4) Both states possess small fleets of light cruisers, but neither of these was in a position to affect the course of military operations.

(5) At the very outset Southland aircraft attacked Northland aerodromes at Leuchars and Donibristle, and inflicted heavy losses on the Northland aircraft, and by June 5 Southland had gained temporary superiority in the air.

Special Idea.

Southland Order of Battle is shown in Schedule A.

(1) When war was declared, all information pointed to the probability that the 1st Northland Division and 1st Northland Cavalry Brigade would not complete mobilization before midnight, June 9/10, and that owing to a slower mobilization these formations could not be supported in the vicinity of the frontier before June 15 at the very earliest.

(2) The latest intelligence in the hands of the Southland's Commander was as follows :—

(*a*) At Haddington—two companies Infantry, one squadron Cavalry.

(*b*) At Edinburgh—1 Infantry Brigade, 1 Cavalry Regiment, 1 Field Artillery Brigade, and Auxiliary Services.

(*c*) The Forth Defences consisting of four 9·2, fourteen six inches, and guns of lesser calibre mounted at Kinghorn, Inchkeith, and Leith Fort.

(*d*) 1st Northland Division and 1st Cavalry Brigade (less portion mentioned in (*a*) and (*b*), mobilizing at Edinburgh) mobilizing at Perth. 2nd Division mobilizing at Aberdeen. 3rd Division at Glasgow, but it was unlikely that this division could complete mobilization before the first days of July.

(*e*) The non-aggressive policy of the Northland Cabinet had resulted in a total lack of defensive measures other than weak frontier guards. No military preparations had been allowed to be made except the normal mobilization scheme for the Field Army, (e.g. no preparations have been made for demolitions in the vicinity of the frontier).

The Southland Commander therefore decided, as soon as mobilization was completed, to assume the offensive and march on Edinburgh with the general plan of defeating decisively the 1st Northland Division before it could be reinforced and of upsetting the arrangements for the mobilization and concentration of the Northland Army by the capture of Edinburgh, an important railway junction.

(3) As a result of Southland air reconnaissances on June 9, and from other sources of information, it appeared that the high ground north and south-east of Haddington was occupied by small bodies of Northland troops and that there was considerable movement on the railway southwards from Perth.

Infantry and guns were observed detraining at Eskbank and Prestonpans. Accordingly the Southland 1st Corps and 1st Cavalry Brigade which was under orders of the 1st Corps continued their movement westwards.

At 16.00 hours on June 9 the 1st Southland Corps after a march of an average of thirteen miles was billeted and bivouacked in the areas shown below :—

Schedule A.

Corps Cavalry Regiment.

1st Lancers, with 1st Armoured Car Coy. attached	On general line Broxburn (D. 10, Sheet 33) Sprott Mill (E. 9).

1st Division.

1st Inf. Bde.	Cockburnspath area (D. 1, Sheet 34) with outposts on the general line of the Dunglass Burn.
1st F.A. Bde.	
1st P.A. Bde. (less 1 Batt.) ...	
1st Fd. Coy. R.E.	
1st Field Ambulance	

1st Division—continued.

2nd Inf. Bde. ... 2nd F.A. Bde.... ... 1st Batt. 1st P.A. Bde ... ... 2nd Fd. Coy. R.E. ... ... No. 1 Sect. (A Echelon) D.A.C. 2nd Field Ambulance	Dowshiel Wood (E/F. 1) Grant's House. (F. 2) Renton House area.
3rd Inf. Bde. ... ... 3rd F.A. Bde. ... ... 3rd Fd. Coy. R.E. ... ... 1st F. Park Coy. R.E. ... ... 3rd Field Ambulance	Brockholes Cottage — Houndwood area.
Divisional Train	Houndwood House area, with supply sections on their way forward to meeting points.
D.A.C. (less 1 Sect.)	Houndwood House area.
1st Divisional Headquarters ...	Grantshouse.

2nd Division

4th Inf. Bde. ... ... 4th F.A. Bde. ... ... 2nd P.A. Bde. (less 1 Batt.) ... 4th Fd. Coy. R.E. ... ... 4th Field Ambulance	Oldhamstocks (F. 11/12, Sheet 33)—Whinhouse area, with outposts on the general line Oldhamstock's Mains—Cocklaw Hill.
5th Inf. Bde. ... ... 5th F.A. Bde. ... ... 1st Batt. 2nd P.A. Bde. ... 5th Fd. Coy. R.E. ... ... 5th Field Ambulance ... ... No. 1 Sect. (A Echelon) D.A.C.	Fulfordlees (F/G. 12)—Ecclaw Hill—Bellstruther Bog area.
6th Inf. Bde. ... ... 6th F.A. Bde. ... ... 6th Fd. Coy. R.E. ... ... 2nd F. Park Coy. R.E.... ... 6th Field Ambulance	Quixwood Moor (F/G. 1, Sheet 34)—Moor House—Blackerstone area.
D.A.C. (less 1 Sect.) ... ... 2nd Divisional Train	Hoardweel (H. 1, Sheet 34) with supply sections on their way forward to meeting points.
2nd Divisional Headquarters ...	Fulfordlees (F/G. 12, Sheet 34).

1st Cavalry Brigade.

1st Regiment	Kingside School (H. 8, Sheet 33).
2nd Regiment	St. Agnes.
3rd Regiment ... ... Battery Royal H.A. ... ... 1st Cav. Fd. Ambulance ... Brigade Headquarters	Cranshaws area.

1st Cavalry Brigade Train	Ellamford (J. 11).
1st Corps Headquarters	Ayton (G. 5, Sheet 34).
1st Medium Artillery Bde. ...	Myrtlehall (E. 3).
2nd Medium Artillery Bde. ...	Press Castle (F. 4).
1st and 2nd Tank Battalions ...	Grange Plantation.
Supply Railhead	Reston (C. 4).
Medical Railhead	Burnmouth (G. 6.)
Ammunition Railhead	Berwick.
Royal Air Force.	
1st Wing Headquarters ...	Ayton.
1st Squadron (Army Co-operation) affiliated to 1st Division	Ayton.
3rd Squadron (single seater fighters)	Berwick.
2nd Squadron (Army Co-operation) affiliated to 2nd Division	Ayton.

4th and 5th Squadrons (day bombing and long distance reconnaissance) and 6th Night Bombing Squadron—Beal (8 miles south of Berwick-on-Tweed).

Note.—Divisions are responsible for air reconnaissance up to a line—Longniddry (E. 2)—Pencaitland (G. 2)—Soutra Hill (K. 3).

1st Air Defence Brigade Headquarters—Ayton.

Headquarters 1st Anti-Aircraft Artillery Brigade and a proportion of 1st A.A. Searchlight Battalion—Renton House.

Headquarters 2nd Anti-Aircraft Artillery Brigade and a proportion of the 1st A.A. Searchlight Battalion—Ayton.

Units not mentioned may be located as convenient.

Note.—The road Fulfordlees—Whinhouse (F. 12) shown uncoloured on the map is practicable for all arms.

Schedule B.

Order of Battle.

Southern Army.

1st Corps. 1st and 2nd Divisions.
1st Cavalry Brigade.
1st Armoured Car Company.
Corps Artillery.
Two Tank Battalions.
Two Air Defence Brigades.
Six Squadrons Aeroplanes.

Northern Army.

1st Corps. 1st, 2nd and 3rd Divisions.
1st Cavalry Brigade.

Northern Army—continued.

1st Armoured Car Company.
Corps Artillery.
Two Tank Battalions.
One Air Defence Brigade.
Three Squadrons Aeroplanes.

According to the mobilization scheme of these two states, the above forces will be augmented at the end of two months by approximately 3 Divisions in each case.

Schedule A.

ORDER OF BATTLE—SOUTHLAND.

Note :—To allow 1st Corps Headquarters to function as General Headquarters it is augmented by the Directorates laid down in War Establishments Part XXVI. A. (Small Wars).

1st Corps Headquarters.

Cavalry.

1st Cavalry Brigade Headquarters.
1st, 2nd and 3rd Cavalry Regiments.
"A" Battery R.H.A. and one section Brigade Ammunition Column.
1st Field Troop R.E.
1st Cavalry Brigade Signal Troop.
1st Cavalry Brigade Train, (H.T.)
1st Cavalry Brigade Field Ambulance.
1st Cavalry Brigade Mobile Veterinary Section.
1st Mounted Provost Section.

1st Division.

1st Divisional Headquarters.
1st, 2nd and 3rd Infantry Brigades.
Headquarters, 1st Division Artillery.
1st, 2nd and 3rd Field Artillery Brigades.
1st Pack Artillery Brigade.
1st D.A.C.
Headquarters, 1st Division, R.E.
1st Field Park Company, R.E.
1st, 2nd and 3rd Field Companies, R.E.
1st Divisional Signals.
1st Divisional Train.
1st, 2nd and 3rd Field Ambulances.
1st Sanitary Section.
1st Mobile Veterinary Section.
1st Provost Company.

2nd Division.

2nd Divisional Head Quarters.
4th, 5th and 6th Infantry Brigades.
Head Quarters, 2nd Division Artillery.
4th, 5th and 6th Field Artillery Brigades
2nd Pack Artillery Brigade.
2nd D.A.C.
Head Quarters, 2nd Division, R.E.
2nd Field Park Company, R.E.
4th, 5th and 6th Field Companies, R.E.
2nd Divisional Signals.
2nd Divisional Train.
4th, 5th and 6th Field Ambulances.
2nd Sanitary Section.
2nd Mobile Veterinary Section.
2nd Provost Company.

Corps Troops.

Corps Cavalry.

1st Lancers.

Corps Artillery.

Head Quarters Corps Artillery.
7th and 8th F.A. Brigades, with Brigade Ammunition Column.
1st and 2nd H.A. Brigades.
1st R.A. Survey Company.

Engineers.

1st and 2nd A.T. Companies.
1st E. and M. Companies.
No. 1 Light Bridging Park.
1st Field Survey Company.

Air Defence.

1st Air Defence Bde. (2nd Air Defence Bde. is protecting the L. of C.).

Royal Air Force.

1st Wing Head Quarters.
1st and 2nd Army Co-operation Squadrons.
3rd Fighting Squadron.
4th and 5th Day Bombing and Long Distance Reconnaissance Squadrons.
6th Night Bombing Squadron.
1st Balloon Section.
1st Aircraft Park.

Signals.

1st Corps Signals.
7th and 8th F.A. Brigade Signal Sections.
1st and 2nd M.A. Brigade, Signal Sections.
1st A. A. Signal Company.

R.A.F.

1st Wing Head Quarters, Signal Section.
1, 2, 3, 4, 5 and 6 Squadrons Signal Sections.
1st Balloon Signal Section.
1st Aircraft Park Signal Section.

Tanks.

1st Tank Brigade Head Quarters.
1st and 2nd Tank Battalions.
1st Armoured Car Company.
1st Tank Salvage Company.

Supply and Transport.

Nos. 1 and 2 Railhead Supply Detachments.
No. 1 Auxiliary H.T. Company.
1st and 2nd Divisional M.T. Companies.
1st Cavalry Brigade M.T. Company.
1st Corps Troops M.T. Company.
1st M.A.M.T.Company.
1st Tank Corps M.T. Company.
1st Reserve M.T. Company.
No. 1 Advance M.T. Vehicle Reception Depot.

Medical.

7th Field Ambulance.
3rd Sanitary Section.
Nos. 1 and 2 Casualty Clearing Stations.
1st Motor Ambulance Convoy.
No. 1 Advanced Depot Medical Stores.

Ordnance.

1st and 2nd Ordnance Mobile Workshop (Light).
3rd Ordnance Mobile Workshop (Medium).
No. 1 Ammunition Company.
No. 1 General Stores Company.

Veterinary.

No. 1 Veterinary Evacuation Station.
No. 1 Advanced Depot of Veterinary Stores.

Provost.

3rd Provost Company.

Note :—(1) Line of Communication Troops, Postal and Pay Units of the Corps troops will not be considered.

(2) Establishments will be as laid down in Provisional War Establishments (Small Wars) 1st June, 1923.

(3) Road spaces will be as laid down in Road Space Tables issued under C.R. Sc. C. 3/18290 (G) dated November 19, 1923.

The Medical Officers taking part in the Staff Exercise were distributed as follows:—

D.D.M.S., Southland Force—Colonel "A" (Regular).

(*a*) A.D.M.S., 2nd Division, Lt.-Col. "B" (T.A.)—D.A.D.M.S. Captain "X" (R).

(*b*) A.D.M.S., 2nd Division, Lt.-Col. "C" (T.A.).—D.A.D.M.S. Captain "Y" (R).

S.M.O. Cavalry Brigade, Major "D" (Regular).

The General and Special Ideas were issued on May 19, and on the same day the medical directing staff issued to each medical officer notes of the experiences gained on previous Staff rides as well as the following instructions and requirements.

COMMAND STAFF TOUR, 1924.

(1) For the purpose of this exercise the General Officer Commanding of the 1st Southland Corps is the Commander-in-Chief of the Southland Forces.

(2) The D.D.M.S., 1st Southland Corps, A.D.'sM.S., and D.A.D.'sM.S., of formations and S.M.O. Cavalry Brigade, in submitting medical appreciations from the point of view of the D.D.M.S. of the Force, will include in the siting of medical units the following:—

One General Hospital, 1,200 beds, for each division.
One General Hospital, 600 beds, for each division.
One Convalescent Depot.
One Base Depot Medical Stores.
One Auxiliary Motor Ambulance Company (R.A.S.C.).
One Sanitary Section.
One Bacteriological Laboratory.
One Hygiene Laboratory.
One Dental Centre.
Two Ambulance Trains.

And such additional medical formations as they may consider necessary to meet the situation.

(3) Required:—

(*a*) A medical appreciation from each officer attending the Command Staff Tour, from the point of view of D.D.M.S., Southland Forces, to reach the office of the D.D.M.S., Scottish Command, by the first post on Saturday, May 31.

(*b*) Medical arrangements of D.D.M.S., 1st Corps, after 4 p.m. on June 9. In reading the narrative the force is to be considered as having concentrated and moved out two days' march to its present positions. The D.D.M.S. will forward copies of his medical arrangements to A.D.'s.M.S. and D.A.D.'s.M.S. of formations and S.M.O. Cavalry Brigade, to reach these officers by the first post on June 2, as well as a copy to reach the office of D.D.M.S., Scottish Command, the same date.

(*c*) The A.D.'sM.S. and D.A.D.'sM.S. and S.M.O. Cavalry Brigade, will issue their medical arrangements from the point of view of the A.D.M.S. of the formations concerned, forwarding copies to reach the office of the D.D.M.S., Scottish Command and the D.D.M.S. Southland Force (Colonel "A") by the last post on June 5.

(*d*) For the remainder of the Staff Tour, officers appointed to the same formation will syndicate.

Medical Appreciations.

The medical appreciations arrived in schedule time, and on the whole were good. This is all the more creditable as none of the officers, except one had previously written an appreciation, or had any experience in Staff exercises.

What is considered the best appreciation and the worst are given below with the criticisms by the directing Staff in each case.

Medical Appreciation of the Situation (A).

Reference O.S. Sheets 33 *and* 34, 1 *inch to* 1 *mile.*

(1) *Strength.*

General Headquarters furnishes the following information as to the forces engaged :—

Southland.—Southland is mobilizing one Corps, consisting of one Cavalry Brigade, two Infantry Divisions, and Air Force detachment and auxiliary services. The total strength is approximately 52,000. Mobilization will be complete on night June 7 to 9.

The organization and equipment of the Force are of the most modern type, the standard of training is excellent, and moral is high. The health of all ranks leaves nothing to be desired.

Newcastle is the capital, the entire State being comprised by the six northern counties of England, plus Berwickshire and Roxburghshire. The country is mainly agricultural, but has large industrial centres in the neighbourhood of Manchester.

Communications are by road and railway, the latter being a double-line track throughout the length of the L. of C. (approx. sixty-four miles).

The Navy consists of a small cruiser force only, and will not affect the conduct of land operations. There are no ports north of Newcastle which can accommodate transports or hospital ships.

Northland.—Northland Force consists of one Corps or one Cavalry Brigade, three Infantry Divisions, an Air Force detachment and auxiliary services. Total strength is approximately 75,000.

Equipment is similar to that of Southland, but organization and training are faulty, and moral has been adversely affected by recent Government policy. Mobilization will be slower than that of Southland,

and it is not anticipated that more than one Division and one Cavalry Brigade will be encountered near the frontier before June 15.

Edinburgh is the capital of the State, which is comprised by the whole of Scotland, less Berwickshire and Roxburghshire. The country is agricultural, Edinburgh and Aberdeen being the only large towns.

Communications are by road and railway: the railway system centres on Edinburgh.

The Navy is similar to that of Southland, and will not affect land operations.

The mobilization scheme of both States provides for augmentation of the above forces by three Divisions in August, in each case.

(2) *Intention.*

Southland Commander intends to advance on Edinburgh, defeating the 1st Northland Division before it can be reinforced, and then to upset the Northland mobilization and concentration by the capture of Edinburgh, which is the vital railway centre of Northland.

(3) *Medical Arrangements.*

Medical Services of both States are as per War Establishments, and, in addition, Southland possesses a well-organized and efficient Red Cross Society, and excellent hospitals in her industrial areas.

Voluntary aid organization of Northland is poor, but good hospital accommodation exists at Edinburgh and Aberdeen.

The following medical units are being mobilized with the Southland army, in addition to its divisional medical organization:—

Two General Hospitals, each of 1,200 beds.
Two General Hospitals, each of 600 beds.
One Convalescent Depot.
One Base Depot Medical Stores.
One Auxiliary Motor Ambulance Convoy (R.A.S.C.)
One Sanitary Section.
One Bacteriological Laboratory.
One Hygiene Laboratory.
One Dental Centre.
Two Ambulance Trains.

Additional medical units are considered necessary, and these are detailed in paragraph 9.

Special requirements in view of special casualties are detailed in Summary.

(4) *Topography.*

The area to which operations at the outset will probably be confined is a strip of land of an average depth of ten to twelve miles from the coast, extending from Berwick to Edinburgh. This strip is traversed throughout

its length by the main Berwick—Edinburgh road and by a double-line railway.

From Berwick to East Linton the country is moderately hilly, rising abruptly from sea-level to an average height of 500 to 600 feet. This high ground terminates eastwards in the high ridges of the Lammermuir Hills, east and south-east of Haddington, with a subsidiary ridge north and north-west of Haddington. East of Haddington the country again falls to the average level of 500 to 600 feet.

The entire area is well watered, two main rivers running through it from east to west, viz., the Eye Water and the White Adder. These are shallow and swift, and rise from smaller streams in the Lammermuir feature, east and south-east of Haddington. There are numerous smaller tributary streams to both rivers.

Between the frontier and Berwick the confused mass of high ground is intersected by roads both numerous and good. The main road, Berwick—Edinburgh, follows the line of the East Coast Railway, is in first-class condition, and has no severe gradients. Many of the smaller roads, especially in the Lammermuirs, have bad surfaces and severe gradients.

Two branch railway lines (single) exist between the main line and Eyemouth and Haddington.

The coast ports, Berwick, Burnmouth, Eyemouth and Dunbar, are small tidal harbours, unsuited for any but the smallest coast-wise traffic.

(5) *Country—General.*

Northland climate is temperate, and no extreme variations of temperature may be expected during June, July and August, which are locally reckoned to be the best months of the year. But the possibility of heavy rainfall cannot be overlooked.

With the exception of the Lammermuir area, and its high moorland to the south and west, the ground is highly cultivated. Farms are numerous, large and well stocked. Buildings are good. There are numerous small woods.

Villages of moderate size, and are mostly located on, or in immediate vicinity of the main Berwick—Edinburgh road. East Linton and Haddington are small country towns.

The inhabitants are not actively hostile; little movement of the civil population between the Frontier and Haddington has been reported. Supplies are plentiful, and may be reckoned to be so as far as Haddington, beyond which point it should be assumed that the country will have been cleared of stocks.

(6) *Prevalent Diseases.*

Other than cases of influenza, the common infectious fevers, and sporadic cases of typhoid, among the civil population, there is no information as to special disease in the area of operations. Our troops show 100 per cent protection against typhoid and smallpox.

Venereal disease is likely to be negligible in amount until Edinburgh is reached, when a considerable increase may be anticipated. A scheme for the provision of adequate "E.T." accommodation to meet this contingency is in course of preparation.

The sick rate will be low during good weather, but may be expected to rise rapidly if broken weather and heavy fighting are met with.

(7) *Wounds.*

Shell and bullet wounds will predominate, and the nature of the soil makes it certain that tetanus and gas gangrene will supervene in many wounds.

Northland is known to possess considerable stocks of gas-shell, and "gas" casualties may be reckoned upon. Special requirements for this class of case are enumerated in paragraph nine and summary.

(8) *Estimation of Casualties.*

These have been estimated as follows:—

Approximate strength of Southland	52,000
3/5 of strength of Southland...	31,680
Battle casualties: 10 per cent of 3/5 of Force (10 per cent of 31,680) = 3,168	
Of this total (3,168), 20 per cent are reckoned as killed and missing	633
Remaining wounded	2,535
Of this remainder (2,535), 10 per cent do not require treatment beyond the field ambulances, etc. ...	253
Remainder of wounded who require train transport and hospital accommodation	2,282

Daily Sick.—These have been estimated at 0·3 per cent of Force. 0·3 per cent of 52,800 is 158·4, which is hereafter reckoned for convenience as 160.

In the absence of accurate statistics the average stay in hospital has been assumed to be twenty-one days, and further it is assumed that—

60 per cent are discharged after 7 days
25 " " " 14 "
15 " " " 21 "

60 per cent of 160	96
25 " " 160	40
15 " " 160	24
	160

CALCULATIONS IN SUPPORT OF ABOVE FIGURES FOR DAILY SICK ARE GIVEN ON SHEET 16.

Bed Accommodation Required.

For wounded	2,282
,, sick	1,580
,, 50 per cent reserve	1,931
	5,793

For convenience this figure is reckoned as 5,800.

Percentage of bed accommodation to total Force is 10·9.

Two General Hospitals, each of 1,200 beds, are mobilized, and will be capable of expansion to 1,800 beds each. Total 3,600.

Two General Hospitals, each of 600 beds, are mobilized, and will be capable of expansion to 1,200 beds each. Total 2,400.

Total beds provided on mobilization	6,000
,, ,, estimated as required	5,800
Surplus	200

(9) *Distribution of Units.*

One General Hospital of 1,200 beds (expands to 1,800), and two General Hospitals, each of 600 beds (expand to 1,200 beds each) at Newcastle.

One General Hospital of 1,200 beds (expanding to 1,800 if necessary) at Berwick—if approval of staff be obtained—for reception of special classes of casualties, e.g., gas cases, wounds of head and thorax, etc. It is considered advisable to open such a hospital at Berwick in view of the certain congestion on the railway to the South, and the fact that such cases bear transport badly.

One Convalescent Depot on the coast, if possible, near Newcastle.

One Base Depot Medical Stores at Newcastle.

One Auxiliary Motor Ambulance Company, R.A.S.C. (a Line of Communication unit) at Newcastle.

One Sanitary Section with Corps Headquarters at Ayton.

One Bacteriological Laboratory at Newcastle.

One Hygiene Laboratory at Newcastle.

(In absence of definite information as to the mobility of these two Laboratories, they have been assumed to be Base Units.)

One Dental Centre with a Casualty Clearing Station—probably at Reston or Grantshouse.

Two Ambulance Trains based at Newcastle.

The following additional medical units are considered necessary, and will be sited as follows:—

Two Casualty Clearing Stations, one to be at Eyemouth on June 8, and open in so far as may be necessary to deal with the sick evacuations,

etc. The second to be at Burnmouth ready to move forward on June 9, to Reston, Grantshouse, or Cockburnspath, according as situation permits and railway facilities allow.

One M.A.C. at Reston.

One Advanced Depot Medical Stores at Burnmouth.

One Advanced Convalescent Depot at Eyemouth.

One Mobile Laboratory (Bacteriological) at Ayton.

One Mobile Laboratory (Hygiene) at Ayton.

Two Sanitary Sections per Line of Communication.

One Water Tank Company R.A.S.C. at Ayton.

Two Foden-Thresh Lorries for disinfection of "gassed" clothing.

(10) *Summary.*

(*a*) Wastage of sick and wounded is reckoned at 0·3 per cent and six per cent respectively of the whole force.

(*b*) Normal scale of reinforcements is considered sufficient.

(*c*) Evacuation requires careful consideration of time and space problems on the road in view of the large amount of mechanical transport employed with the Force. No great difficulty is anticipated as regards the railways, but provision of one General Hospital at Berwick, and an advanced Convalescent Depot is considered necessary to relieve a possible delay of evacuation by this means.

(*d*) Ample stocks of anti-tetanic serum must be maintained.

(*e*) Cylinders of oxygen will be required in the treatment of gas cases, and leather gloves and linseed oil for the protection of hands of stretcher-bearers, etc. Estimated requirements of these articles will follow.

G.H.Q. S.F.

ESTIMATION OF DAILY SICK.

Day	Daily admissions	Daily totals	Discharged daily	Remaining	Remarks
1	160	160	—	160	
2	160	320	—	320	Assumed that average
3	160	480	—	480	stay in hospital =
4	160	640	—	640	21 days
5	160	800	—	800	
6	160	960	—	960	
7	160	1,120	96	1,024	Daily sick = 0·3 per
8	160	1,184	96	1,088	cent, i.e., 0·3 per cent
9	160	1,248	96	1,152	of 52,800=158·4, or
10	160	1,312	96	1,216	160 (approx.)
11	160	1,376	96	1,280	
12	160	1,440	96	1,348	
13	160	1,508	96	1,412	60 per cent discharged,
14	160	1,572	136	1,436	7th
15	160	1,596	136	1,460	25 per cent ,, 14th
16	160	1,620	136	1,484	15 per cent ,, 21st
17	160	1,644	136	1,508	
18	160	1,668	136	1,532	
19	160	1,692	136	1,556	
20	160	1.716	136	1,580	60 per cent of 160=96
21	160	1,740	160	1,580	25 per cent of 160=40
22	160	1,740	160	1,580	15 per cent of 160=24
					160

REFERENCE YOUR MEDICAL APPRECIATION.

The following remarks are forwarded for your information. (Marks seventy-five per cent.)

(1) Your strength is too low. The approximate strength is 64,000.

(2) Topography, from Berwick to East Linton should read Berwick to Cockburnspath.

(3) Prevalent Diseases. You have omitted scabies, lice, and encephalitis lethargica. You should have gone into more details with reference to prevention of venereal disease, including lectures by company officers. (Details of venereal prevention and Provost Marshal's Regulations in reference to prostitution.)

(4) Distribution of units. It is inadvisable to utilize the power of expansion of your hospitals at the beginning of a campaign as it absorbs your potential reserve for emergencies. It is considered that the area Burnmouth—Berwick may be compared to Boulogne, i.e., overseas base, while Newcastle would represent United Kingdom, consequently it appears necessary to have more hospital beds available in Burnmouth—Berwick area.

(5) As Berwick is behind medical railhead it is not likely that any Staff difficulties at siting hospitals in that area would arise. You should site your convalescent depots (base and advanced) in close proximity to general hospitals to lessen transport wastage.

Your base depot medical stores should be at Berwick—Newcastle, hospitals drawing direct from army medical stores in the capital.

Your arrangements for casualty clearing stations are not clear. These mobilize one per division and should be located at Ayton, No. 1 open and the other loaded on train garaged at Ayton station.

Grantshouse and Reston are too far forward for dental centre and casualty clearing station at the present period.

Your ambulance train should be garaged at Burnmouth—Berwick area. Your motor ambulance convoy should be at Ayton. One additional sanitary section for line of communication should suffice.

It is not considered that the Water Tank Company, R.A.S.C., and two Foden-Thresh lorries for disinfection of gassed clothing are necessary.

(6) What about specialists? You make no arrangements for sick Nursing Sisters, prisoners of war, enemy civilians, infectious or venereal cases.

(*Signed*) DIRECTING STAFF (Medical).

MEDICAL APPRECIATION OF THE SITUATION (B).

(1) *Strength of Forces Engaged.*

Southland Force of Corps Headquarters, Corps troops and two Divisions, is approximately 40,000: two months later, three Divisions added, bringing total to 100,000 of all arms.

No interference of enemy aircraft or fleet is anticipated.

Northland (enemy) Force of one Division and one Cavalry Brigade, i.e., 22,000 men mobilized by June 9-10. Two Divisions mobilizing, three more expected to mobilize in two months time.

(2) *Intention and Policy.*

A short campaign is aimed at, to be effected by the capture of Edinburgh as early as possible, to upset enemy arrangements for mobilization of 2nd and 3rd Divisions (at Aberdeen and Glasgow).

(3) *Medical Arrangements—Requirements.*

Rapid evacuation of sick and wounded to base, to ensure mobility of field units.

(*a*) *Estimation of Casualties.*—No special risk of abnormal numbers of sick, as the campaign is taking place in this country and the special diseases, etc., need not be considered.

(i) Sick admission rate may be taken as low, say not more than 0·25 per cent of the total force, i.e., 100 a day, of whom probably 50 per cent will be fit in 7 days and 25 per cent in fourteen days. This leaves 25 per cent of the sick in hospital over fourteen days, and allowing 5 per cent invalided, the occupied beds in general hospitals will increase to say 650 a month.

(ii) *Battle Casualties.*—An estimate of 10 per cent of three-fifths of the force gives 2,500: deduct 20 per cent killed, leaving 2,000 wounded to be dealt with after an action, 200 of these (10 per cent) will not need evacuation to base. The total number of wounded to be accommodated on any one day is probably 1,800. Number of beds required is therefore 650, 1,800, add twenty-five per cent reserve beds, viz., 600, giving a grand total of 3,050.

From the above estimate it would appear that two General Hospitals to each Division, i.e., 3,600 beds in all, will be ample for immediate needs and would allow of one 600-bedded hospital being held unopened in reserve.

(iii) *Nature of Casualties.*—At first bullet wounds are likely to predominate, later shell wounds with gas gangrene cases owing to the cultivated ground over which fighting will take place.

(*b*) *Siting of Medical Units.*—Berwick would be the most suitable place for the medical base. *Two* 1,200-*bedded, and one* 600-*bedded* hospitals should open as soon as possible, the other 600-bedded hospital held in reserve.

Bacteriological and hygiene laboratories and dental centre also in the town, preferably attached to one of the hospitals.

Base medical stores in a suitable building.

A convalescent depot of say 1,000 beds in huts or tents within easy distance (able to expand).

One ambulance train should be based in Berwick to run to medical railhead at Burnmouth as required.

Burnmouth, ten miles north on the main line, is medical railhead. No. 1 Casualty Clearing Station should open at this point; No. 2 Casualty Clearing Station remain in reserve, ready to move as required.

Advanced depot medical stores and 1st M.A.C. Headquarters should establish here. One section M.A.C. might be allotted to each division to work under orders of A.D's.M.S.

One ambulance train based here, to work alternately with the other to Berwick as required.

Note.—The possibility of needing a second M.A.C. or sections should be considered and provisionally arranged for. Field medical units will be disposed of under A.D's.M.S. Divisions, who notify D.D.M.S. Forces of their locations and time of opening.

The 7th Field Ambulance and 3rd Sanitary Section should be established at or near Headquarters at Ayton, when the former unit could deal with all base troops forming aid posts and detachments as needed.

Further Provisional Arrangements.

(1) In the event of a successful advance it is presumed that medical railhead would be advanced, possibly to Reston (junction for single St. Boswell's line) or to a similar point on the main line.

In this case No. 2 Casualty Clearing Station should proceed to new railhead and open. No. 1 Casualty Clearing Station to evacuate patients and to be held in readiness for moving along the northern or western line according to circumstances.

By this time the question of opening the second 600-bedded General Hospital could be decided. Movements of field units to be nctified to D.D.M.S., by A.D.M.S. Division.

(2) In case of non-success and retirement one or more hospital ships or equivalents should be in readiness to sail for Berwick, or Burnmouth if possible, to assist in rapid evacuation.

For the present it is not proposed to deal with medical arrangements for the further three divisions to be mobilized in two months' time. Such provisional arrangements considered necessary should be proceeded with, on receipt of definite information that these divisions would be employed.

D.D.M.S. should be in touch with local Red Cross Society representatives whose assistance should be welcomed, and to whom facilities should be given.

Consultants :—

Two Consulting Surgeons.
One Consulting Physician.
One Specialist—eye diseases.
One Specialist—ear, nose and throat.
One Specialist—mental diseases.

would be necessary and appointed. These officers should work under the direct instructions of D.D.M.S.

(*To be continued.*)

OBSERVATIONS ON THE GROWTH OF MENINGOCOCCI *IN VITRO* IN RELATION TO VIRULENCE.[1]

A REPORT TO THE MEDICAL RESEARCH COUNCIL ON WORK CARRIED OUT AT THE UNIVERSITY OF CAMBRIDGE PATHOLOGICAL LABORATORY AND FIELD LABORATORIES.

BY E. G. D. MURRAY AND R. AYRTON.

I.—INTRODUCTION.

EVERY bacteriologist is only too well aware of the many problems presented by the preparation of culture media for the growth of bacteria *in vitro.*

At present it is quite impossible to put forward a constructive generalization outlining the principles of bacterial nutrition, based upon observed facts of bacterial metabolism.

A very large number of media have been described and certain of them are sufficient for the growth *in vitro* of many diverse bacteria; but the outstanding feature of our present degree of knowledge, in so far as pathogenic microbes are concerned, is the statemeut that each "species" behaves, to a greater or less extent, in a manner peculiar to itself.

It has long been recognized that special precautions have to be observed in order to obtain growth of certain parasitic bacteria and that the organism in question can be accustomed to grow upon what are described as the ordinary culture media in the course of a few subcultures. The question immediately arises, apart from the mere satisfaction of having obtained a culture of a given organism, whether these acclimatized bacteria may be regarded as possessing the physiological characters necessary to their parasitic existence. Our investigation of this problem, as applied to the meningococcus, constitutes the main subject of this paper.

Murray (1924) emphasized the important relation of medium to the determination of the minimal lethal dose of a meningococcus culture, but he purposely refrained from a detailed description of the medium he used in order that it might be considered in greater detail here.

There is another question which is of considerable importance to immunologists and which receives some attention in this paper, namely, the maintenance of meningococcal cultures *in vitro* over a sufficiently long period without loss of "virulence."

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[1] Reprinted from the *Journal of Hygiene*, vol. xxiii, No. 1, October 15, 1924, by kind permission.

II.—The Estimation of the Growing Power of a Medium.

The literature abounds with so many different formulæ, whereby it is recommended to make media for growing the meningococcus, that it is legitimate to suspect that a satisfactory medium yet remains to be discovered. Each entrant into this field of research finds cause for dissatisfaction in the existing formulæ and proceeds to elaborate another. Still, that there are so many formulæ indicates that the meningococcus can be grown quite readily and that a method is required for measuring and comparing the capacity of the various media to promote growth.

The method we have used for measuring the growing power of media during the last seven years is the following :—

The surface of an agar medium, in Petri dishes, is inoculated with a chosen organism in a manner to ensure confluent growth. Convenient areas, as large as possible, are then ruled out on the glass surface of the plates and the growth over as many areas as possible is scraped off with a small sterile metal spade, made for the purpose ; the growth so obtained is immediately placed in sterile weighing bottles with carefully ground stoppers and weighed. Then the stoppers are tilted and the bottles placed in a desiccator over NaOH, at reduced pressure and 37° C. and they are kept under these conditions until the weight becomes constant.

In this way the amount of moist living growth per square centimetre surface of medium, the amount of dried bacterial protoplasm per square centimetre and the percentage of moisture in the original growth are then easily computed. The usual precautions in weighing must be observed and the stoppers must be set in the bottles immediately the desiccator is opened because the dried bacteria are markedly hygroscopic.

We have frequently attempted to estimate, by naked-eye comparison, the relative amounts of growth obtained on a number of different media, all inoculated at the same time, and we have been somewhat astonished to observe how far removed from the truth our guesses were when they were compared with the actual weights of growth obtained from known areas. This in spite of a not inconsiderable experience of massive cultures of various organisms in the Army Vaccine Department during the war and elsewhere. We emphasize this point in order to demonstrate that any naked-eye method, whereby the amount of growth yielded by different media is to be estimated by looking at it in situ, is wholly untrustworthy. It has been our experience that a very clear medium frequently gives a much more transparent growth of meningococcus than does some other medium not so completely freed of suspended matter, and in many such cases we have guessed that the more transparent growth was the lower yield per unit area, whereas actually the reverse was true. Thus we have come to the conclusion that the only reliable estimation of the amount of growth obtained on a medium is one based upon actual measurement of the yield per unit area and the measure we have chosen is weight.

However carefully the various manipulations necessary to this measure-

ment of growth are carried out, there is a considerable margin of error which is unavoidable at present. It is chiefly due to what may be called the adventitious moisture and this is determined very largely by the fluid exuded from the agar when it sets and the amount of water condensed when the plates cool. Both factors are difficult to control.

The amount of exudation moisture we regard as depending upon the firmness or rigidity of the jelly formed by the agar. It is our experience that a low concentration of agar means a moister surface when set than does a high concentration and this exudation moisture is in reality the nutritive medium and it contains a goodly proportion of solids. Other things being equal, there is a moderate degree of surface moisture most favourable to meningococcal growth and degrees of moisture varying markedly on either side of this diminish the amount of growth yielded. It may be that a too rigid jelly holds the nutrient solution too tenaciously for its ready accessibility to the micro-organism and that a too sloppy surface is approaching towards culture in a fluid medium.

The condensation moisture can be reduced by not using plates which expose a very large surface for condensation and by having the plates at a slightly warmer temperature than the medium at the time of pouring. Even so the lid and walls of the plate cool more quickly than the body of the agar and the condensation moisture is found to be very variable.

It might be suggested that the surface of the agar be dried in the usual way in the incubator but it must be remembered that agar readily forms a hard surface "skin" which is very unfavourable to meningococcal growth.

The error introduced by the inexact measurement of the area scraped can be diminished by scraping sufficiently large areas. With normal cultures the growth is removed very completely and the amount left behind is negligible compared to the possible error in the opposite direction which is introduced if care is not taken to avoid pressing on the surface and in so doing squeezing fluid out of the jelly.

In spite of these unavoidable errors the various measurements are sufficiently comparable to yield useful results and very considerable variations are revealed which, nevertheless, cannot be detected by the eye.

There is another point of importance which might easily be overlooked, if the amount of moisture the growth contains were not considered, that is the age of the culture at the time the growth is measured. If the yield of growth per unit area of the same medium is compared after twenty-four hours' and forty-eight hours' incubation, it is found that the latter shows but a small increase in mass on the former; so little in fact that it is well within the range of variation of successive subcultures on the same medium. But when the amount of moisture in growth of different ages is determined, it is found that the dried bacteria obtained from the forty-eight hour culture and expressed as a percentage of the moist growth, may be 1·5 to 2·5 times the percentage yielded by the twenty-four hour culture. Therefore it is very important that all measurements which are to be

compared one with another should be made after approximately equal incubation.

The time interval we have chosen to incubate our cultures for the purpose of measuring growth is twenty-four hours. This choice was determined by the convenience it offered in the investigation of the growth yielded by successive subcultures on a given medium; although we use much younger cultures (fourteen to sixteen hours) for virulence tests, because autolysis is then very much less marked than it is in older cultures, and presumably a greater proportion of the cocci are viable and there is less chance for interference by liberated endotoxin.

Even greater difficulties are encountered in the endeavour to obtain a standard inoculum for the plates in order to have really comparable measurements of growth. We are far from having succeeded in this; particularly when successive generations are studied.

III.—The Variation in Growing Power Exhibited by Media.

It is universally recognized that different kinds of media may give widely varying yields of growth, but perhaps it is not sufficiently realized, not only that different batches of any medium made by a described method give noticeably differing results, but that there is a considerable variation in yield of growth on any one batch.

The figures given in Table I, compiled from batches of media on which a sufficient number of observations have been made, are instructive.

The first point we wish to emphasize is that the yield of meningococcal growth per unit area, whether in terms of moist growth or dried cocci, varies enormously in different cultures on the same batch of medium and that these differences are usually not perceived by naked-eye examination. It is for this reason that Murray (1924) stressed the point that it is not possible to establish a constant minimal lethal dose for a strain of meningococcus in terms of agar slopes, Roux bottles, etc., as has often been attempted.

But still more important, from the point of view of the present paper, is the large difference between the figures representing the variation for any one batch of medium and the figures derived from observations of a number of batches representing the variation for the kind of medium. These variations are brought out particularly well when expressed as a percentage increase or decrease on the arithmetical mean for the separate batches and for the kind of medium, and we claim that the divergence between the sets of figures demonstrates that it is extremely difficult to make two batches of medium exactly alike. We have taken a great deal of trouble in attempting to make media of uniform quality, but the above figures show that we have not succeeded to any great extent. Nevertheless, that we have not failed altogether is demonstrated by the figures representing the dried cocci as a percentage of the moist growth. It is clearly shown that in "Trypagar" and "*EDB/N*" the variations for the

TABLE I.

Medium	Yield of moist growth per sq. cm. in mgm.				Yield of dried growth per sq. cm. in mgm.				Dry as % of moist growth			
	Maximum	Arithmetical mean	Minimum	Maximum and minimum as % increase or decrease on mean	Maximum	Arithmetical mean	Minimum	Maximum and minimum as % increase or decrease on mean	Maximum	Arithmetical mean	Minimum	Maximum and minimum as % increase or decrease on mean
Trypagar No. 3 ..	1·75	1·45	1·20	+20·7 −17·2	—	—	—	—	—	—	—	—
5 ..	1·68	1·63	1·55	+ 3·1 − 4·9	0·329	0·304	0·273	+ 8·2 −10·2	22·0	19·9	17 6	+10 8 −11·3
6 ..	1·40	1·29	1·15	+ 8·5 −10·9	0·243	0·223	0·175	+ 9·0 −21·5	18 1	16·8	14·7	+ 7·5 −12·5
3 batches of Trypagar taken together	1·75	1·43	1·15	+22·4 −19·6	0·329	0·258	0·175	+27·5 −32·2	22·0	19·0	14·7	+15·8 −26·3
EDB/N No. 36 ..	3·11	2·73	2 27	+13 9 −16·9	0·524	0·448	0 380	+17·0 −15·2	16·9	16·2	15·5	+ 4·3 − 4·3
37	3·40	2·85	2·06	+19·3 −16·9	0·562	0·488	0·413	+15·2 −15·4	20·1	17·3	15·8	+16·2 − 8·7
48 ..	2·77	2·63	2·44	+ 5·3 − 7·2	0·500	0·437	0·388	+14·4 −11·2	19·0	17·3	15·1	+ 9·8 −12·7
63 ..	2·54	2·12	1·79	+19 8 − 15·6	0·488	0·415	0·355	+17·6 −14·5	22·2	19·6	18·0	+13·3 − 8·2
72, 73 ..	2·53	2·30	1·91	+10·0 −17·0	0 460	0·406	0·349	+13·3 −14·0	19·3	17·6	15·8	+ 9·7 −10·2
14 batches of *EDB/N* taken together	3·40	2·38	1·44	+42·9 −39·5	0·[illegible]62	0·432	0·227	+30·1 −47 5	22·2	18·0	15·1	+23 3 −16·1
EDB/S No. 105 ..	2·21	1·90	1·52	+16·3 −20·0	0·436	0·364	0·300	+19·8 −17·6	19 9	19·3	17·9	+ 3·1 − 7·3
110 ..	1·74	1·63	1·54	+ 6·8 − 5·5	0·338	0·335	0·333	+ 0·9 − 0·6	21·6	20·3	19·4	+ 9·0 − 4·4
5 batches of *EDB/S* taken together	2·51	1·83	1·19	+37·2 −35·0	0 546	0·369	0·296	+48·0 −19·8	21·9	19·9	17·9	+10·05 −10·05
EHD/V No. 196 ..	3·8	3·2	2·6	+18·8 −18·8	0·67	0·51	0 43	+31·4 −15·7	17·7	16·1	14·8	+ 9 9 − 8·1
198 ..	4·0	3·1	2·3	+29·0 −26·0	0·75	0·52	0·40	+44·2 −23·1	18·9	16·8	15·1	+12·5 −10·1
202 ..	3·9	2·8	2·2	+39·3 −21 4	0·60	0·45	0 36	+33·3 −20·0	16·8	16·2	15·8	+ 3·7 − 2·5
209 ..	2·7	2·1	2·0	+28·6 − 4·8	0·48	0·35	0·30	+37·1 −14·3	17·5	16·4	15·2	+ 6·7 − 7·5
4 batches of *EHD/V* taken together	4·0	2·8	2·0	+42·9 −28·6	0·75	0·45	0·30	+66·6 −33·3	18·9	16·3	14·8	+15·3 − 9·2

batch and those for the medium diverge widely; but on turning to "*EDB/S*" it is seen that there is a much closer correspondence between the two sets of figures. The importance of this point has been discussed already (Murray, 1924) and need not detain us here.

It would appear that in obtaining this degree of success in making "*EDB/S*" medium, a proportion of the yield of growth per unit area had to be sacrificed and even were this necessary it would be worth while. Nevertheless, this does not entirely represent the truth, for further study of this type of medium has enabled us to make a medium, "*EDB/V*" or "*EHD/V*" from which we obtain a yield of growth even superior to "*EDB/N*" without losing the stability of the percentage yield of dried cocci characteristic of "*EDB/S*." Other experiments now in progress seem to promise still further improvements. We do not claim that the superiority of the latest form of our medium over those previously used is entirely due to any one factor, for it is exceedingly difficult to determine the effect of varying even one constituent because its influence is often closely bound up with the general balance of the remainder. In order to realize the result of an alteration it is frequently necessary to re-examine the whole question, by determining the optimal concentration of each constituent of the medium in relation to the primary alteration of the factor under examination. To do this very thoroughly would almost be a life's work because of the infinite number of possible combinations. We shall, however, attempt, in Sections IV and V, to give an indication of the influences of the separate constituents of the medium.

Here we would draw attention to the fact, that the average yield of growth on our *EHD/V* medium is really a very large mass for the meningococcus. The figures given for medium 209 in Tables I and II were obtained using a strain which normally gives smaller growth on any medium than any strain used to obtain the other figures in the tables.

We have shown that there is a very considerable variation in yield by different cultures on the same batch of medium. One aspect of this fact has been referred to as a periodic wave of growth by Murray (1924, p. 180), in its bearing upon the correct measurement of a dose of living cocci for injection into animals. We cannot, however, demonstrate a regular periodicity. In Table II we give the figures obtained in measuring the amount of growth yielded by media with successive subcultures at twenty-four hour intervals (= generations) of a strain of meningococcus. The plates were inoculated sufficiently heavily to try to be sure of confluent growth.

There is one point we wish to emphasize because it bears an important relation to the establishment of a minimal lethal dose for living meningococcus cultures: that subsequent to the second generation on a medium the yield of growth in successive subcultures at twenty-four hour intervals almost always exhibits more pronounced variation. The growth obtained in the first two generations may be described as being on the up-grade and

TABLE II.

Successive generations		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Modified Trypagar No. 27 Strain "Netley"	M	—	1·46	1·90	1·61	1·41	2·06	1·51	1·70											5th generation growth not confluent
	D	—	0·226	0·346	0·263	0·240	0·366	0·253	0·320											
	°/₀ D	—	15·5	8·2	16·1	17·0	18·3	16·7	8·8											
EDB/N No. 36 Strain "Netley"	M	—	2·97	3·11	2·47	2·53	2·65	3·10	2·27											6th generation confluent growth on one plate only (scraped), the others discrete colonies
	D	—	0·480	0·520	0·384	0·415	0·433	0·524	0·380											
	°/₀ D	—	16·1	16·7	15·5	16·4	16·3	16·9	15·5											
EDB/N No. 37 Strain "Netley"	M	—	2·92	2·06	3·12	3·40	2·76													3rd generation one plate confluent (scraped), one discrete colonies, and one no growth
	D	—	0·460	0·413	0·562	0·556	0·449													
	°/₀ D	—	15·7	20·1	18·0	16·4	16·3													
EDB/N No. 63 Strain "Netley"	M	—	2·08	1·89	1·97	2·03	1·96	2·06	2·43	1·79	2·49	2·01	2·41	2·38	2·54	1·85	1·87	1·84	2·44	6th gen. one plate discrete colonies not scraped
	D	—	0·420	0·356	0·386	3·376	0·436	0·413	0·464	0·358	0·485	0·406	0·437	0·488	0·455	0·363	0·375	0·355	0·484	
	°/₀ D	—	20·3	18·8	19·6	18·5	22·2	20·1	19·1	20·0	19·4	20·2	18·1	20·5	18·0	19·6	20·0	19·3	19·8	
EDB/S No. 105 Strain "Netley"	M	—	1·92	1·70	1·83	1·98	1·88	2·11	1·92	1·91	2·07	1·74	2·21							
	D	—	0·353	0·318	0·327	0·371	0·351	0·404	0·373	0·380	0·407	3·344	0·436							
	°/₀ D	—	18·4	18·7	17·9	18·8	18·7	19·2	19·5	19·9	19·7	19·8	19·7							
EHD/V No. 202 Strain 28	M	3·44	2·87	3·47	2·64	2·30	—	2·21	3·85	2·58	2·25									6th gen. all plates discrete colonies. 11th gen. no growth
	D	0·546	0·423	0·546	0·422	0·381	—	0·356	0·603	0·423	0·380									
	°/₀ D	15·9	14·7	15·8	16·0	16·5	—	16·1	15·6	16·4	16·8									
EHD/V No. 209 Strain Pettigrew	M	2·04	2·00	2·17	2·01	2·08														
	D	0·316	0·305	0·365	0·306	0·361														
	°/₀ D	15·4	15·4	16·8	15·2	17·4														

M = Moist weight in mgm. per sq. cm. D = Dried weight in mgm. per sq. cm. °/₀ D = Dried growth as a °/₀ of moist growth.

when a culture is used for the inoculation of mice with purpose to determine the virulence of a strain, we consider it important to be reasonably sure that the growth is on the up-grade. For that reason we select the first, or more usually the second, generation for virulence tests. The effect of successive subculture, at intervals greater than twelve hours, on the killing power of a strain also makes it desirable to use as early a generation as possible; but this question will be raised again in Section VI (Table XI).

This question of marked fluctuation in the yield of growth on a given medium is one which deserves closer consideration than we have been able to give to it, and, probably, it involves physiological processes which are important to the micro-organism.

It is possible that a sufficiently even and regular growth would result if the viable state of the inoculum used for the successive generations was reasonably constant, and the fact that this condition is very difficult to realize suggests very strongly that the variation in yield of growth, on a given batch of medium, is due to the state of the organism rather than to the medium. For some time past we have made it a rule to take only discrete colonies growing at the margin of an inoculated area as the inoculum for the succeeding generation, but, although this is an improvement, it does not interfere appreciably with the usual fluctuation or even the occasional complete death of a culture.

IV.—An attempted Standardization of a Medium.

Having considered the variation in yield exhibited by media, the ground is cleared for the examination of the various phases of preparation of the medium and to discuss their relative values. It is unnecessary to recapitulate what is known of the substances found in media which successfully grow parasitic bacteria, since we have nothing to add to the broad classification of them to be found in books dealing with the nutrition of living organisms. That with which we are more intimately concerned is the manipulation of the raw materials ordinarily used for media making and we shall show that this subject still provides a wide field for research of which we have barely touched the fringe.

Broadly speaking the type of medium we are considering consists of a watery extract of fresh meat, to which is added the products of tryptic digestion of meat, inorganic salts and accessory growth substances in the form of body fluids and exudates or extracts of animal or plant tissues. This complex mixture is usually held in a jelly of agar and clarified by the coagulation in it of some albuminous substance. The reaction is adjusted to a desired degree of acidity or basicity and it is then sterilized by raising it to the thermal death-point of living matter.

It is with the details of these various manipulations that we wish to deal in this section.

(*a*) *The Meat Extract.*

The tissue we confine ourselves to for the present is bullocks' heart muscle and we consider it a matter of primary importance to use only freshly killed meat: we refuse any which has been dead for more than twenty-four hours. This is freed of fat and the larger vessels, not too finely minced and extracted with one litre of tap-water to each 500 grammes of mince at between 70° and 75° C. for three hours. After that the temperature is raised rapidly to 100° C.; a large amount of protein is thus coagulated and this is immediately preceded by an evolution of gas (93° to 95° C.). The water lost during heating is made up by adding distilled water to the original weight of the mixture, which is then filtered. The filtrate is bright and perfectly clear and is of pinkish-yellow colour. We have made numerous observations on the weight of the meat before and after extracting and pressing and also on the volume of the fluid yielded as a finished product, and we find that between fifty and sixty per cent by weight of the meat is yielded up to the extract. The filtered extract is bottled and sterilized at 120° C. for twenty minutes when a further coagulation takes place and the pinkish tinge is lost. During the last six months we have made our extracts with *distilled* water and on autoclaving the resulting filtrate it retains more of the ruddy tinge and there appears to be considerably less secondary coagulation. We believe the substitution of distilled water for tap water to be a marked improvement, for additional reasons to be discussed in the subsection dealing with the influence of certain inorganic salts.

The constancy of the product obtained in this way is shown by the figures given in Table III.

TABLE III.

Extract No.	Total solids grms. in 100 c.c.	Ash grms. in 100 c.c.	Total Cl, grms. in 100 c.c.	Total N, grms. in 100 c.c.	Sörensen figure (see text) in c.c. $N/10$ NaOH on 10 c.c.	c.c. $N/100$ NaOH required to raise reaction of 1·0 c.c. from pH 7·0 to pH 8·0 to phenol red	Notes
40	1·56	0·41	0·035	0·166	1·7	0·6	Tap water
132	1·76	0·33	0·035	0·136	1·5	0·5	,,
134	1·45	0·36	0·035	0·144	1·7	0·7	Distilled water
158	1·52	0·36	0·053	0·150	2·1	0·6	,,
163	1·58	0·41	0·035	0·158	1·8	0·7	,,
199	1·40	0·44	0·035	0·140	1·8	0·9	,,

The method we have elaborated for filtering the meat extract deserves mention because it is very much more rapid than filtration through paper and is quite as efficient.

A sheet of fine butter-muslin is pinned on to a wooden frame in such a way that when the frame is rested in a large funnel the bag formed by the muslin does not touch the funnel. The extract and meat are stirred up and when the main part of the coarse meat has settled, leaving the fine coagulum still in suspension, it is rapidly poured into the wetted muslin bag so as to fill it. The fine coagulum settles uniformly on to the muslin

and forms the actual filter, the excess of coarse meat is scooped out with a cup and returned to the can and the filter is then left undisturbed until the filtrate runs clear; this takes less than five minutes. Meanwhile the vessel containing the extract has stood undisturbed and the meat has settled together with the fine coagulum. The supernatant fluid, together with the first runnings, is now decanted into the centre of the filter, taking care not to fill above the filter-bed on the muslin and without unduly disturbing either the filter-bed or the meat in the can. When the bulk of the fluid has been poured off from the meat, the can is balanced on the wooden frame at an angle to allow the remaining fluid to drain away into the filter, leaving the meat behind with most of the fine coagulum entangled in it. In this way we are able to save hours of time compared with filtration through paper. Starting with 1,200 grammes of meat and 2,400 cubic centimetres of water, 2,000 cubic centimetres of perfectly clear filtrate was obtained in fifteen minutes, and 2,650 cubic centimetres in less than fifty minutes without pressing the meat residue.

(*b*) *The Digest.*

At the commencement of the present investigations we selected "Trypagar" (Gordon, Hine and Flack, 1916) as our routine medium, but we soon observed that it was extremely difficult, if not impossible, to make two batches sufficiently alike; the variation we observed is illustrated in Table I. In a previous investigation (unpublished) it was observed that the production of toxin by dysentery bacilli varied with the batch of medium and the medium then used had one point in common with "Trypagar" in that both are made with Douglas broth as a basis. We thought that in making Douglas broth the variable which was least under our control was the degree of digestion undergone by the meat and we decided to add a digest to a meat extract in such a proportion that every batch of medium would have an identical concentration of amino-acids, as determined by titration in the presence of formaldehyde. The amino-acid concentration in different digests varied considerably, but in the finished medium the increment of amino-acids in ten cubic centimetres of medium, due to added digest, neutralized 2·5 cubic centimetres $N/10$ NaOH (=approximately an $N/40$ solution). This figure was determined by experiment to give maximum growth.

In making the digest no strict precautions were taken at first to exclude contamination and the presence of micro-organisms was easily demonstrated, although growth during the time allowed was slight in the high concentration of the products of tryptic digestion which accumulated very rapidly, but anaerobes were usually sufficiently numerous to cause an unpleasant smell.

The medium made in this way we call "*EDB/N*" (*E*=extract, *D*=digest, *B*=blood, and *N*=non-sterile digest) and the variation it exhibited is shown in Table I. These figures show a much improved yield of growth

when compared with "Trypagar," but in other respects this medium has no particular claim to superiority. The growth when scraped off in mass had a curious flesh-pink tinge which was not seen in growth from "Trypagar," but which obtains with all our media of the *ED* type. Although we used this medium extensively and the growth which it yielded per unit area was satisfactory, we shall not consider it in detail because it would unduly burden this paper to describe every step in the investigation. We propose to consider as briefly as possible only the chief points which led to the development of the technique we have provisionally adopted.

At this stage we thought that some degree of control over the concentration of amino-acids in the medium was the all-important factor. However, in attempting to determine the virulence of strains of meningococcus grown on this medium, we obtained ample evidence of the inconstancy which has been so commonly emphasized as characteristic of that organism. But it must be remembered that at that time we had not recognized the more important details of technique which it is essential to observe in order to determine the virulence of a culture and to ensure the successful repetition of an experiment. We were contented for the time being with the idea that maximal growth indicated a good medium and assumed that such a culture was healthy and probably possessed the physiological characters of the disease-producing meningococcus.

Nevertheless we were uneasy about what might be the influence of the slight but mixed infection of the digest on the efficiency of our medium and so proceeded to digest the meat with such strict precautions that contamination was completely avoided. Such sterile digests were used to make the medium called "*EDB/S*" (*S* = sterile) in Table I, maintaining the same increment of amino-acids. At first we were greatly disappointed with this medium because of the poor yield of growth per unit area compared with *EDB/N*, but an examination of the properties of the growth caused us to abandon *EDB/N* as a bad medium; but we have learned since that it was the general adjustment of the medium which was at fault and not the digest (see Section V, Table VIII). Two of our reasons are illustrated in Table I: firstly, the moisture represented as a percentage of the living growth is much less variable than the media used up to this time; secondly, the yield of dried growth per unit area is not greatly inferior to *EDB/N*. A third reason, to which we attached considerable importance, must be stated briefly here although it will be dealt with in greater detail later. Batches of both *EDB/N* and *EDB/S* then in use were inoculated from the same culture of a given strain of meningococcus and it was found that the growth from the former failed to kill mice and rats whereas the growth from the latter killed quite regularly. This result was confirmed with certain other batches of these media. Although the interpretation of these results is a matter of difficulty, it appeared to be evident to us that there was a difference in the physiological state of the bacteria as grown on these media

and that the mass of growth yielded by a medium was less important than the killing power of a culture.

At this time the general treatment, the relative concentrations of meat, water and trypsin, and also the reaction and time of digestion were as near as we could make them alike for the different digests, but the contaminated digests always showed a very much higher concentration of "amino-acids," in terms of cubic centimetres $N/10$ NaOH in the presence of formaldehyde, than the sterile digests did. This is probably due to an enterokinase-like substance supplied by the contaminating bacteria (see Richet and Richet, 1921, p. 1060).

However, since the amino-acid increment due to digest in the finished medium was the same in both *EDB/N* and *EDB/S*, the property it is desirable to control is definitely independent of the general amino-acid figure, determined by titration in the presence of formaldehyde. This is indicated by both growth and killing power (see Section V).

In order to investigate this matter further numerous experiments were made to determine approximately the conditions necessary to allow the sterile digests to contain an equally high concentration of amino-acids as the contaminated digests, and guided by the results of this investigation we have adopted the following method of making our digest :—

Immediately after the extract has been drained away the residual meat mince is suspended in as many litres of $N/100$ HCl as there were kilos of original fresh meat before extraction, and put into a flask fitted up so that samples can be withdrawn and sterile fluids added when required. This is then autoclaved for thirty minutes at 130° C. to ensure sterility; it is advisable to heat large volumes of material to 100° C. in a water-bath or steamer before putting them into the autoclave. When cooled sufficiently the flask is placed in an incubator at 37° C. and left overnight in order to make certain that the large bulk of material reaches the same temperature throughout and to test for sterility.

The pancreatic extract is sterilized by filtering it through a Pasteur-Chamberland candle "*F*" and is added in the proportion of twenty cubic centimetres to each litre of $N/100$ HCl used. It is essential to add the trypsin to the acid in order that it may be activated (see Richet and Richet, 1921, p. 1060). We have found by experiment that the amount of digestion which takes place in a given time, other things being equal, is very much greater when the pancreatic extract is added to an acid substrate than when it is added directly to one of *p*H 8·0 (the region of optimal reaction for tryptic digestion).

We find that trypsin can be activated quite as well by treating it with $N/100$ HCl before adding it to the meat suspended in an alkaline medium. Adding it to an alkaline medium containing 0·5 per cent $CaCl_2$ (see Richet and Richet, 1921, p. 1060) is also effective.

The routine we have adopted is to add the trypsin to the meat suspended in $N/100$ HCl and after five hours' contact to adjust the reaction to *p*H 8·0

as described subsequently and allow digestion to proceed at 37° C. Originally the reaction was adjusted by adding 10*N* NaOH, and sufficient was added at once to maintain the alkalinity over the desired time; this was found to be fifteen cubic centimetres per litre. As this raised the alkalinity at the commencement slightly more than is desirable we now add the equivalent quantity of Na_2CO_3 (= 0·8 per cent anhydrous Na_2CO_3). We have not found our trouble sufficiently rewarded when we added the necessary alkali at short intervals during the course of digestion, and it increases the risk of contamination. Digestion is allowed to proceed for two to three weeks and during that time somewhere in the region of ten per cent of the meat is digested.

That the degree of digestion is sufficient for our purpose is indicated by titrating the amino-acids in the presence of neutralized formalin, using phenolphthalein as indicator and expressing the result in cubic centimetres *N*/10 NaOH required to neutralize the amino-acids in ten cubic centimetres of the filtered digest: this we call its Sörensen figure and for reasons to be discussed later we require our digest to have a Sörensen figure not less than twenty. The digest is usually very dark coloured and when it is undiluted it is extremely difficult to see the end-point of the indicator. Therefore, in making our titration, 5·0 cubic centimetres of the digest is made up to 25·0 cubic centimetres with distilled water, boiled and rapidly cooled and titrated to the first faint change of the phenolphthalein with *N*/10 NaOH; a similar sample is titrated to the same point and kept as the control colour; 5·0 cubic centimetres of freshly neutralized formalin (forty per cent CH_2O) is now added and the mixture titrated to match the control. This second increment of *N*/10 NaOH represents the Sörensen figure for five cubic centimetres of the digest. We always check the result by adding excess of alkali and allow the mixture to stand for ten minutes, then titrate back with *N*/10 HCl. We have found repeatedly that amounts of formalin up to four cubic centimetres give an increasing Sörensen figure and that amounts over five cubic centimetres do not alter the result. We usually find it necessary to redistil commercial formalin to obtain a satisfactory solution for this titration, otherwise it discolours on neutralization.

(*To be continued.*)

THE ÆTIOLOGY OF PHLEBOTOMUS FEVER.[1]

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"Phlebotomus" or "sandfly fever" is an acute specific fever, common in tropical and sub-tropical countries, caused by a virus, possibly a leptospira, conveyed to man by the bite of a small midge, called phlebotomus or the sandfly. Incubation period is about five days. The disease is characterized by three days' fever, flushed face, suffused eyes, rheumatic-like pains in back and legs, and severe frontal headache. There is no mortality, but convalescence is often prolonged and accompanied by considerable nervous depression. The seriousness of the disease lies in the fact that whole communities may be affected at the same time. These epidemics delay trade, and are a source of danger to forces guarding various outposts of the Empire, especially as the natives in these regions are more or less immune to the disease.

It is interesting to note that the earliest reference to this fever affecting British forces was closely connected with the history of France and Britain. This was in 1799, during the Napoleonic Wars. Sir William Burnett's [1] description of the incident is worth quoting :—

"In the year 1799, while employed in the 'Goliath' of 74 guns, in the blockade of Malta, the ship's company were attacked with a fever, similar to one then prevalent in the island. Our boats had been employed in watering at Marsa Scala, a small harbour to the S.E. of La Valetta, when, from blowing weather coming on, a boat's crew, with her officer, were left on shore all night. A few days after this, the officer was attacked with fever, and several of the boat's crew soon followed . . . "

His description of the fever shows that it was phlebotomus fever.

Phlebotomus fever is one of the chief causes of inefficiency, due to sickness, in the personnel of the Royal Air Force serving overseas [2]. The overseas sickness rate remains very constant throughout the year, except for a marked increase during the months of May, June, July and August. This increase coincides with the incidence of phlebotomus fever. When the sickness rate due to this fever is plotted and the graph superimposed on the total sickness rate graph, the accentuation of the latter curve and the phlebotomus fever curve are found to be practically identical. This fever accounts for about fifty per cent of the cases of sickness in our service overseas. It is of the utmost importance, therefore, that we should have a clear conception of the ætiology of this disease.

Ætiology embraces the true cause and the predisposing conditions.

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[1] A paper read before the Society of Medical Officers of Health in London on June 27, 1924, and reprinted by kind permission.

Unfortunately, the true cause has not been definitely proved, but many of the predisposing conditions have been verified beyond doubt. *Phlebotomus papatasii* has been shown to be the true carrier of the disease, not simply an intermediate host.

Phlebotomus fever is *endemic* wherever the *P. papatasii* can breed, that is in an area where for eight consecutive weeks the mean daily temperature lies between 65° and 90° F. This temperature requirement, and the presence of sufficient moisture and organic debris for the fly to complete its life-cycle, explains the geographical distribution of the disease, and its occurrence in the summer months. Thus, in relatively dry areas it is confined to the coast line, rivers, or oases, that is, proximity to water, or to places where there is a marked drop in the atmospheric temperature at night and consequently a heavy fall of dew. Moreover, in humid areas, such as Malta, there are two waves of fever coinciding with two broods of flies, because the conditions necessary for the life-cycle of the fly reach or approach the optimum, whereas in the less humid Baghdad area only one wave of fever and one brood of sandflies are seen [3].

Epidemics of the fever depend on :—

(1) The number of infected phlebotomi ; and

(2) The number of susceptible people (non-immunes).

The *prime factors* in the ætiology are :—

(1) Virus (leptospira).

(2) Vector (*P. papatasii*).

(3) Recipient (man).

There are a number of conditions which may modify the above prime factors needed for the natural production of the fever.

(1) Virus : (*a*) temperature ; (*b*) humidity ; (*c*) reaction of soil.

(2) Vector : (*a*) species ; (*b*) sex ; (*c*) all flies are not infected ; (*d*) infection is not hereditary ; (*e*) infection is handed on in breeding grounds by larva ingesting dejecta or dead remains of parent flies ; (*f*) non-infected flies can be infected by feeding on man with fever ; (*g*) habits—distance of flight, length of life, number of feeds ; (*h*) climate—temperature and humidity (dews, rains, floods, rivers and irrigation) ; (*i*) geographical distribution.

(3) Recipient (susceptibility) : (*a*) intrinsic factors—natural immunity, good or bad health ; (*b*) Extrinsic factors—atmospheric temperature, atmospheric humidity, fatigue.

(1) The Virus.

Doerr (1909) [4] and Birt (1910) [5] have shown that, in phlebotomus fever, the blood of man is infective by direct transmission to other men only in the first day of disease. Kilroy [6] in 1909, allowed himself to be bitten by phlebotomi, contracted the fever, and then blood withdrawn from his vein during the first day of fever was inoculated into a non-immune man and reproduced the disease.

Birt (1910) [5] showed that the virus could pass through a Pasteur Chamberland filter "F."

Couvy (1921) [7], working in Beiret, reported that a spirochæte was isolated from cases of dengue.

In 1921, the Royal Air Force Sandfly Fever Commission [8] showed the presence of leptospira in six cases of so-called sandfly fever in Malta.

In the Dutch East Indies, Vervoot (1922) [9] and Van de Velde (1922) [10] have found spirochætes in the peripheral blood of three- to five-day types of fever. The cases closely resembled phlebotomus fever. It should be noted that one of the cases reported suffered from jaundice.

The leptospira isolated in Malta were obtained by blood cultures in Wenyon-Noguchi medium [8-11]. Their presence was revealed by dark-ground illumination after five to six days' incubation at 27° C., and morphologically they were indistinguishable from *Leptospira icterohæmorrhagiæ*, the average length being 10 to 15 microns, and width about 0·3 microns. Cultures showed the most abundant growth about three-quarters to one inch below the surface of the medium. In fact, after about ten to fourteen days, in some cultures a fine but distinct white haze formed a ring about an inch below the surface of the medium; this ring consisted of masses of leptospira.

The leptospira differed from the *L. ictero-hæmorrhagiæ* by its non-pathogenicity to guinea-pigs. It has been found, however, that the pathogenicity of cultivated spirochætes may be quickly lost. Griffith (1919) [12] states: "A culture grown at 37° C. which, when a fortnight old, produced typical spirochætosis in a guinea-pig, lost its virulence within the next fortnight. In another experiment with spirochætes grown at 25° C., a fourteen days' old primary culture produced fatal hæmorrhagic jaundice, while the same culture when three and a half and four months' old was completely non-pathogenic." Moreover, spirochætes have been isolated from cases of jaundice in France and Albania, which are non-pathogenic to guinea-pigs.

The point to consider is, were all the cases investigated at Malta true cases of sandfly fever? The varying types of fever met with in Malta from year to year, and even during different stages of the hot weather, have been commented on by many authorities, including very old residents. There have been outbreaks of sandfly fever varying from mild influenza-like attacks to severe forms termed "yellow fever." In fact, yellow fever was reported in Malta in the autumn of 1822, while the fever during the summer was of a milder type. Dr. Lightbody remarked on the absence of the buffy coat (i.e., leucopenia) during the summer, and its presence (i.e., leucocytosis) in the autumn epidemic. Some of the cases investigated in the summer of 1921 showed a slight leucocytosis, some relapsed, one even developed jaundice. It is possible that the leptospira isolated was a modified form of that which causes epidemic jaundice—modified by passage

and perhaps atmospheric conditions. That atmospheric conditions affect the virus was seen when transmission experiments with infected phlebotomi were undertaken in England. Volunteers who were bitten by these infected phlebotomi when the atmospheric temperature had fallen below 60° F. did not contract the fever, whereas those bitten by the same flies when the temperature was above 65° F. developed the disease.

It was decided that the only feasible way to attack the problem was to endeavour to establish definitely the mode of transmission of sandfly fever and to reproduce it in an area free from that fever. Under such conditions any leptospira found would be associated with the disease. With this end in view attention was chiefly centred on the vector of the disease.

(2) The Vector.

Formerly, many points in the ætiology of this disease have, without full confirmation, been accepted as correct. Doerr (1909) [4] and Birt (1910) [5] claimed that *P. papatasii* which had fed on cases of phlebotomus fever were capable of transmitting the disease, but only seven to ten days after sucking virulent blood. Negative results were obtained with flies which had been infected under a week. Doerr made the suggestion that the infection was probably passed by hereditary transmission from the adult female phlebotomus to the succeeding generation. This suggestion was not compatible with his previous findings.

Little knowledge was to be gained from transmission experiments along these lines. The phlebotomus, rightly accused of transmitting the disease, had never had its life-story fully elucidated, nor had it ever been bred in captivity from ovum to imago. Therefore, it was first necessary to re-study the habits of phlebotomi and to attempt to rear these flies in captivity; fortunately, this was accomplished in 1922 and in 1923 in Malta and England, and now several hundreds of the flies have been bred through to maturity [13].

Briefly, the findings of the Royal Air Force Sandfly Fever Commission were :—

(*a*) That *P. papatasii* was the most common species found indoors and to feed on man. All the observations in this paper concern this species.

(*b*) Only the female insects sucked blood. This held good for the four species—*P. papatasii, P. perniciosus, P. nigerrimus* and *P. minutus*—found in Malta. On rare occasions a male was found to ingest blood, but only by sucking up the excess of blood which exuded from a puncture made by a female fly. There was no act of biting.

(*c*) *That all phlebotomi were not infected with the virus of sandfly fever* was suggested by the failure of some flies, which had never had a feed of blood, to infect volunteers in Malta. This failure was not due to natural immunity, for some of the volunteers were infected by other flies at a later date. These results were verified by numerous experiments performed with phlebotomi bred from washed ova (*vide infra*).

(*d*) *That the infection of the insect is not hereditary* was proved in the following manner. Phlebotomi were bred in specially prepared earthenware pots, which were lined and covered with sterilized butter-muslin. These pots were placed in soup plates containing water, so that the lower half-inch of the pot was immersed. The water saturated the butter-muslin lining at the bottom of the pot; above this level varying degrees of moisture were obtained, depending on absorption by the muslin. Moreover, by evaporation of the water, a high degree of humidity was obtained in the air in the pot. The flies chose the level suitable for ovulation. After ten days, when most of the flies were dead, the lining was removed and examined with a lens. The ova were collected, washed quickly in sterile water and placed on moist sterile filter paper. Thereafter, the eggs were triple-washed in sterile water to get rid of any surface contamination. The washed ova were transferred to sterile breeding cages, and, ultimately, adult flies hatched out. These flies were allowed to bite men in England, but they failed to infect any of these volunteers with sandfly fever.

Five volunteers were bitten by phlebotomi that had never partaken of a blood feed. The number of flies that fed varied from 6 to 18, and the number of bites received varied from 15 to 63 in each case. In one instance the bitten area was scarified afterwards.

It was considered that the virus might require to pass through a cycle of several days in the fly before full infectivity was reached. To ascertain this point further volunteers were bitten by phlebotomi that had fed on other men from one to eight days previously. These volunteers were divided up into eight batches, two men being in each batch. The first batch were bitten by flies that had fed on the previous day, the second by those that had fed two days before, and so on. In each instance one member of each group had his bites scarified.

To test the effect of being repeatedly bitten, one person was bitten daily for five days, a second was bitten weekly for four weeks, and a third was bitten every three to four days for two months by flies that had fed on other people previously. The last-mentioned volunteer received 328 bites from 41 different phlebotomi.

Every one of these experiments proved negative. In all 198 flies inflicted 692 bites. These results showed:—

(1) That the virus of the fever was not inherited by *P. papatasii*.

(2) That the saliva of the phlebotomus was not the cause of the fever.

(3) That the fever was not due to the phlebotomus injecting into man some altered product of blood digestion, as has been suggested by Woodcock.

(4) And, naturally, that all phlebotomi were not infected with the virus of the disease.

(*e*) *The infection is transmitted to phlebotomi in their breeding grounds* by the larvæ ingesting the dejecta or dead remains of parent flies was proved by the following experiments:—

Phlebotomi were bred in special boxes, made of wood with a front of glass. A tightly fitting aluminium tray was fitted to the bottom of each box to prevent moisture being absorbed by the wood. The actual breeding grounds were constructed from small pieces of Maltese limestone varying in size from that of a peanut to that of a walnut, with imported garden earth or ordinary Maltese earth, and nitrogenous organic matter in the form of the fæces of lizards, crushed insects, or dried human blood. Before being placed in the boxes all these constituents were sterilized for two hours at 140° C. Water was added to each box daily after sunset, sufficient to moisten the lower levels of the mounds; the exact amount varied with the stage of the life-cycle. For oviposition the soil was kept well moistened, but throughout the non-motile stages of development (maturation of the ovum and pupal life) less moisture was added. During the motile stage (larval life) the water content was increased, for then the larvæ could move about, and select a level holding the necessary amount of moisture. The cages were kept in baby incubators at a temperature of 80° F.

The phlebotomi bred in these cases were reared under sterile conditions, except that the larvæ may have ingested the dejecta or dead remains of the parent flies. If this food supply were to contain the virus of phlebotomus fever those larvæ that ingested it would thus become infected.

The first three volunteers who were bitten by some of these flies did not contract sandfly fever. However, these same flies were allowed to bite two other volunteers five days later, that was five days after their first blood feed, and both developed typical sandfly fever. The incubation period was five days in each case. None of these volunteers had ever been out of the United Kingdom.

It should be noted that the phlebotomi were apparently not infective until after they had had a feed of blood. This may have been due to a period of time being necessary for the virus to develop in the fly, or perhaps the amount of saliva inoculated (dose of virus) was insufficient to cause fever when the previously unfed fly bit. The latter cause was suggested by the fact that two of the first volunteers suffered from malaise, but no fever.

In order to eliminate the question of natural immunity as far as possible, twin brothers were used in these experiments. One twin was bitten by fourteen phlebotomi that had not had a previous feed of blood, but he did not contract fever. The other twin was bitten by the same flies five days later and contracted the disease.

(*f*) *Non-infected flies may become infected by feeding on man with fever*, but this point was not fully elucidated.

(*g*) *The habits of the phlebotomus* were shown to be intimately associated with the spread of the fever.

The distance of flight of the insect was found to be limited to about fifty yards from its breeding haunts. Moreover, the flight was so feeble that the fly avoided all currents of air, natural or artificial. There was a

definite relationship between the force of the wind and the number of flies found indoors; roughly speaking, they were present in inverse proportion to the force of the wind. Upstair rooms, which were more exposed to air currents, were less infected with phlebotomi than those on the ground floor, and the inmates of these upper rooms were relatively free from sandfly fever.

The average female phlebotomus was found to live from ten to fourteen days. Some flies fed daily during this period, but most partook of a blood feed every three to four days. The time taken for a blood feed by a previously unfed fly was about two minutes, whereas a fly that had fed previously, especially if pregnant, took five to ten minutes. These observations helped to explain the infection with phlebotomus fever of volunteers who were bitten by flies that had previously fed on other fever-free volunteers in England. As already stated the volunteers first bitten by previously unfed flies did not contract the fever.

(*h*) Each stage of the life-cycle of the phlebotomus was shown to be governed by such conditions as temperature and humidity.

The earth temperature was important. The insect hibernated when the earth temperature fell below 65° F., or if there was an excess of ground moisture. Hibernation took place in the fourth larval stage. The optimum atmospheric temperature for the hatching out of the imago was between 70° and 90° F.

Excess of moisture was found to be injurious to all stages of the life of the insect.

(*i*) *The geographical distribution of the phlebotomus*, and therefore of the fever, is limited to areas of certain temperature and humidity. For pupation the earth temperature (four foot) must be maintained above 65° F. for at least ten consecutive days.

(3) Recipient.

(*a*) *Intrinsic factors.* The recipient, man, was shown to play an important part in the ætiology of this disease. There were undoubted cases of natural immunity—four men who had never been overseas before proved immune to the fever, although they were bitten by infected flies in Malta on several occasions. The percentage of Europeans who escaped infection was not great, about 10 per cent.

A decrease in the resistance to phlebotomus fever was observed in some cases. There was a recurrence of the fever in 15 per cent. of the cases, after a period varying from twenty-five to forty-six days. Two cases had three attacks of the fever in the same year. It was difficult to say whether they were instances of relapse or re-infection.

(*b*) *Extrinsic factors* such as atmospheric temperature and humidity were found to affect the development of the virus in man. Thus, flies that had produced fever in man in England, when the atmospheric temperature

was above 65° F., failed to infect other men, during the following week, when the temperature fell suddenly to between 50° and 54° F.

From the foregoing it is obvious that *P. papatasii*, the insect vector, plays the chief rôle in the ætiology of this disease. To prevent phlebotomus fever, it is most important to understand the mode of development of this insect, and to know its breeding places.

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WAZIRISTAN DISTRICT.

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At the conclusion of the military operations against the Wazir and Mahsud tribes in April, 1923, the force, named "Wazirforce," operating against these tribes remained in occupation of certain parts of the tribal country.

The peace terms with the tribes included the right to construct roads, to open up the country and to station troops permanently where required.

The interest of this new District to Royal Army Medical Corps officers coming to India lies firstly in the fact that many of them will be detailed for a tour of service there, limited at the present time to one year for medical officers. Secondly that the bulk of their work will be with Indian troops. This being the case it is felt that some information regarding stations in the district may be of use to officers of the Corps, more especially as the climate and conditions of life in Waziristan differ materially from the conditions prevailing in India.

The alignment of the main strategical road is the principal factor governing the location of the military stations. This main road, generally known as the "circular" road, links up the railhead at Bannu in North Waziristan with the railhead at Khirgi in South Waziristan, joining at the latter place with the previously existing road to Dera Ismail Khan. The attached map shows the road and the various stations. For the purposes of description the stations fall into two lines, viz., South Waziristan Line and North Waziristan Line.

At this juncture, for the information of married officers, I may say that no accommodation for families exists, nor are women and children allowed to proceed to any station on either line, except at Dera Ismail Khan in South Waziristan and Bannu in North Waziristan. At these places the existing accommodation is reserved for officers stationed there, and practically none is available for the families of officers stationed elsewhere in the District. Consequently those officers must make their own arrangements and the nearest stations where hotel accommodation can be obtained by families are Rawalpindi and Peshawar.

Stations on South Waziristan Lines.

Dera Ismail Khan, 560 *feet.*

Headquarters of Waziristan District. An old-standing Cantonment on the right bank of the Indus.

Accommodation : Fair bungalows, fitted with electric light and fans. Furniture can be obtained on hire.

Climate: A bracing cold weather from November to the end of February. A severe and trying "hot" weather from May to end of September. Women and children go to the hills for the hot weather.

Tank, 850 *feet.*

Climate similar to Dera Ismail Khan. A perimeter camp, hutted.

Accommodation: None for women and children. Officers in mud-brick huts provided by Government at a monthly rental, fitted with electric fans and light. Practically no facilities for local purchase.

Manzai, 1,450 *feet.*

Headquarters of the 10th Indian Infantry Brigade. A perimeter hutted camp situated on an absolutely bare plateau in the foothills.

Climate: Very cold in winter months (October to March). Severe heat in summer months (May to mid-September).

Accommodation; Tents or mud-brick quarters (monthly rental for both) fitted with electric light and fans. A desolate-looking camp where one cannot move outside the perimeter without an escort.

Khirgi, 1,650 *feet.*

A small fort. Headquarters and one company of Indian infantry. The water supply of Manzai is pumped up from the Takki Zam and piped to Khirgi.

Climate: Like Manzai.

Accommodation: Like Manzai.

Stations on the North Waziristan Line.

Bannu, 1,250 *feet.*

An old-standing cantonment. Headquarters of the 8th Indian Infantry Brigade. Cantonment surrounded by barbed wire entanglement.

Accommodation: Fair bungalows fitted with electric light and fans. Furniture can be hired locally. Usual cantonment shops.

Climate: Good in cold weather (November to February). Severe and trying in hot weather (May to October). Women and children go to hill stations.

Idak, 2,477 *feet.*

A perimeter camp. Not allowed outside without escort.

Accommodation: Tents or mud-brick Government quarters. Monthly rental. Electric light and fans.

Climate: Pleasant cold weather. Severe hot weather.

Damdil, 4,000 *feet.*

Perimeter camp. Not allowed outside without escort.

Accommodation: Tents only at present. Quarters will be erected in course of time.

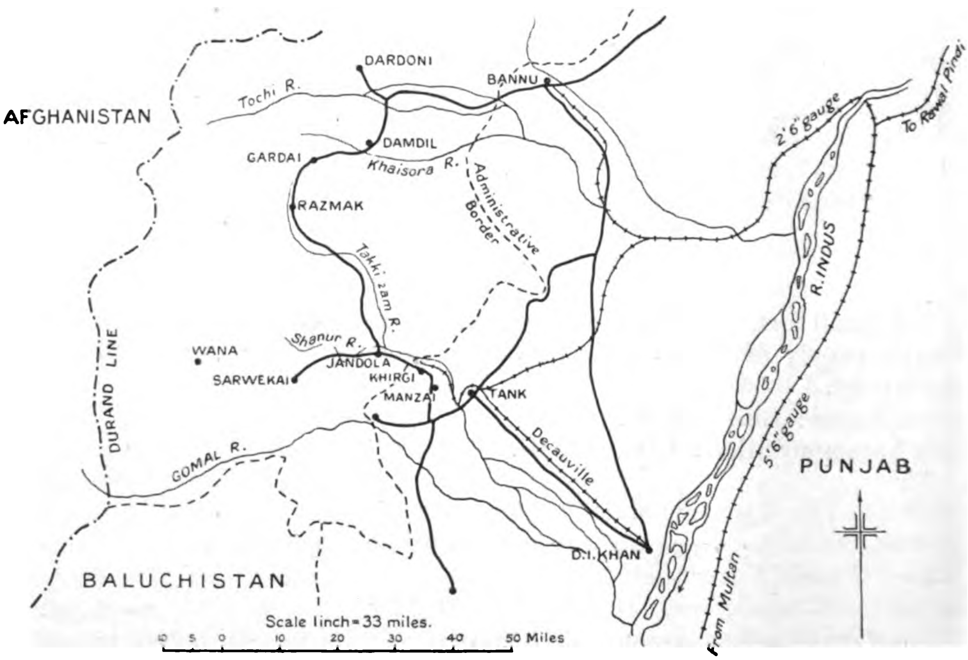
Climate: Good cold weather. Moderate hot weather, but trying.

Gardai, 5,250 *feet.*

Headquarters, 9th Indian Infantry Brigade. Perimeter camp, protected by permanent picquets.

Accommodation: Tents only. Huts to be provided later.

Climate: Severe winter, with snow at times. Cool hot weather.



Razmak, 6,500 *feet.*

Headquarters, 7th Indian Infantry Brigade. Perimeter camp, protected by permanent picquets, containing the mobile column consisting of 7th Indian Infantry Brigade and additional holding troops. The largest military station in Waziristan.

Accommodation: Partly tents and partly huts. To be completely "hutted" in time. Electric light.

Climate: A "first class" Hill Station. Severe winter, with a lot of snow. Cool in summer. Constantly subject to "sniping." Cannot go outside perimeter wire without escort.

The figures given refer to the height above sea-level. For purposes of comparison Rawalpindi and Peshawar are 1,687 and 1,149 feet respectively.

Mobile columns, complete with field ambulances, are kept ready for action at Razmak and Manzai. These columns march at intervals through the tribal territory to "show the flag."

The strength of Royal Army Medical Corps officers in Waziristan at present is: Lieutenant-Colonels, 2; Majors, 5; Captains, 7.

The normal method of travel is by motor car, motor lorry or Ford vanette. People are only allowed to travel during certain specified hours, when the road is protected by troops or levies. Every officer must carry a loaded revolver when travelling on account of the possibility of fanatical attacks.

Officers are advised to bring up only kit for games, grey flannel trousers, blazer, &c., but except in Dera Ismail Khan or Bannu store suits are not necessary.

A little "scatter" gun shooting can be obtained under organized arrangements.

THE CORRESPONDENCE CIRCLE.

By Major M. B. H. Ritchie.
Royal Army Medical Corps.

III.

Peace Stations in the Tropics. The "Cold Storage" Conception.

A tropical station that is unhealthy on account of malaria during some months of the year is usually looked upon as a necessary evil. The evil is mitigated in part by the removal of a portion of the garrison to a hill station, and by the provision of anti-malarial measures. This seems to be the narrow view, and it is time that we began to think big about the malarial problem. One is apt to forget that many stations which contribute largely to the admission rate for malaria were chosen in the old days when it was necessary to keep troops within striking distance of a possible storm centre, such as a turbulent Native State, the distance being two days' march or less. And we accept the fact that the station is there, and has always been there, and that a European garrison is essential.

We should remember, however, that mobility and communications have been revolutionized in the last few years by the advent of aircraft, tanks, motor lorries and armoured cars. Also, the dimension of mobility is no longer *distance*—it is *time*. Thirty miles was once two days' march, but by using post-war methods of transportation, troops can be concentrated at a greatly increased distance in much less time. Moreover, they arrive fresh, and not fatigued by a long march in hot weather.

In most countries where malarious stations still exist healthy hill stations exist also, within two days' distance of storm centres. Thus the elimination of malaria from the European soldier in peace is not entirely a question for the doctor, as the administrator could do so much by rearranging many peace stations in the light of post-war transportation facilities, without detracting from the positions demanded by the requirements of strategy.

The ideal peace station should be somewhat in the nature of a cold store, where expensive, perishable articles can be kept without undergoing deterioration. The British soldier is expensive both to create and maintain, and he is perishable if he is not properly looked after. As it is a matter of financial and strategical importance that he should always be ready for active service in the event of trouble arising unexpectedly, we should aim at keeping him free from a disease like malaria, a prince of casualty-producers.

The point is whether more could not be done towards the eradication of malaria by viewing a peace station in the light of a cold store. Not

everywhere, but in some localities, it should be possible to close a station during the malarious months, and so have a malaria-free force up in the hills, with a few motor lorries standing by for emergencies. It is towards the wider conceptions of its utility, such as this, that hygiene is advancing, summoning to its aid any new military developments that can simplify disease prevention; anti-malaria measures are not limited to the provision of mosquito nets and the destruction of breeding places. It is trivial to look at these big problems through a microscope. We have got to stand right away and get the wide, broad view. The medical man who has not been gifted with a scientific mind need not feel himself handicapped, for there is an unlimited field for anyone who cares to develop the administrative side of the profession. He has to think big, and try to solve health problems by means of modern developments. There is abundant room for the growth of medical statesmanship.

Our Uniform and our Badge.

It has been suggested that the Circle might be able to get information on one or two points connected with the badge and uniform of the R.A.M.C. Twenty-seven years is a short space of time, and there must be several readers of the Journal who can relate the circumstances that led up to the adoption of facings of dull cherry, and the creation of a badge that has since been borne in honour by thousands in peace and war over most parts of the globe. And whose inspiration was it to select a motto so peculiarly appropriate?

With regard to the laurel wreath that encircles the rod of Æsculapius, it may not be generally known that this was a mark of special distinction in the British Army, having been granted to the 34th for Fontenoy, the five regiments that fought at Minden, and the 57th for Albuhera, in commemoration of the gallantry displayed by these regiments. As the laurel wreath on our badge is stated to represent "the achievements of the Medical Service of the Army," it is probable that this circumstance was realized when the badge was designed; intentionally or otherwise, it was bestowed upon a Corps eminently worthy of receiving a special distinction.

Scarlet *versus* Blue.

Another point raised was the question of uniform—whether we should have scarlet or blue. At the end of the war officers were asked for their opinions on this question, and I think that most were in favour of blue, but with red facings on account of being a Royal Corps. At that time, no one quite realized that the world of our day would be so desperately hard-up.

When you go beyond khaki, the utilitarian, to seek for a colour, the chances are that you dip into a history book. Scarlet is essentially British, while the blue uniforms of many regiments in the Army are due to continental influences, as Hussars and Lancers. Some of these influences

are Teutonic in origin. Also, it was the colour worn by the departments of the Army. Thus in the Crimean days the Army Hospital Corps, administered by the Commissariat Department, had a blue uniform.

On the other hand, the officers of the Army Medical Department wore scarlet, with black velvet facings, as late as 1883. Several officers serving at the close of the Great War joined in the days of scarlet tunics. Scarlet can be seen also in the Millbank portraits; it disappeared when the Army Hospital Corps and the Army Medical Department became the Medical Staff Corps and the Medical Staff respectively, the reason being, perhaps, that the State did not bear the cost of the change of colour to blue, as it would have done if the men had been given the scarlet uniform of the officers.

Blue, therefore, lacks historical significance—it may never have been worn by us in the presence of the enemy—whereas scarlet is the colour of the old uniform of the Medical Service. On this count scarlet leads.

As regards scarlet facings to blue uniform, there appears to be no "Royal" significance attached. Facings of this colour are worn by several non-royal units, as can be seen best by a perusal of the 1914 Army List.

However, we should remember that the British Army, after its series of victories at the close of the Napoleonic epoch, began to pay too much attention to its wearing apparel; in consequence, it dwindled in war efficiency in the decades following Waterloo. Dress must remain within its proper perspective, and in the above I am attempting to treat the question in its historical aspect only. I may have made misstatements, which welcome correction. Living abroad, one is unable to look up references. But I suggest to those who are acquainted with such matters that this Journal should contain information on these and similar subjects. Our Journal is a permanent record in which facts and opinions can remain stored and indexed for those who want to investigate the history of the Corps in future years. The Journal constitutes our Archives, in which everything of interest, scientific, professional, historical and even sartorial, deserves a place.

Diploma of Public Health.

Note supplied by Lieutenant-Colonel J. A. Anderson, Professor of Hygiene R.A.M. College.

When the General Medical Council drew up the new rules for Diplomas in Public Health, which came into force in January, 1924, it was at once seen that they would place officers of the Royal Army Medical Corps under a disadvantage for obtaining this qualification.

The following is a short summary of the Regulations issued by the General Medical Council, including the courses of study required to allow a candidate to sit for either Part I or Part II of this examination :—

Rule 1.—A period of not less than two years must elapse between the attainment by a candidate of a registrable qualification and his admission to the final examination for the Diploma in Public Health.

Rule 2.—The curriculum for the Diploma in Public Health shall extend over a period of not less than twelve months subsequent to the attainment of a registrable qualification.

Rule 3.—Every candidate shall produce evidence of having attended, not less than five months at an approved institution, practical instruction in (*a*) Bacteriology and Parasitology (including Medical Entomology), especially in their relation to diseases of man, and to those diseases of lower animals transmissible to man: (*b*) Chemistry and Physics in relation to Public Health ; (*c*) Meteorology and Climatology.

At least one hundred and eighty hours must be devoted to Course (*a*), of which one hundred and fifty hours shall be spent in the laboratory.

At least ninety hours must be devoted to Course (*b*), seventy hours of which must be spent in the laboratory.

At least ten hours must be devoted to Part (*c*).

Rule 4.—Every candidate must produce evidence of having received not less than eighty hours at an institution, or from teachers approved by the Licensing Board, instruction in: (*a*) Principles of Public Health and Sanitation; (*b*) Epidemiology and Vital Statistics; (*c*) Sanitary Law and Administration ; (*d*) Sanitary Construction and Planning.

Rule 5.—Every candidate must produce evidence of attendance for three months on the clinical practice of a recognized hospital for infectious diseases, and of having obtained instruction in administration. There shall be thirty daily attendances of not less than two hours each week.

Rule 6.—Every candidate shall produce evidence that for six months he has been engaged in acquiring a practical knowledge of the duties, routine and special, of public health administration under the supervision of a medical officer of health, who shall certify that the candidate has received during not less than three hours on each of sixty working days, practical instruction in these duties, and those relating to: (*a*) maternity and child welfare service; (*b*) health service for children of school age ; (*c*) venereal disease service; (*d*) tuberculosis service; (*e*) industrial hygiene; (*f*) inspection and control of food, including meat and milk.

The certificate referred to in Rule 6 can only be given by a whole time medical officer of health, or a medical officer of health of a sanitary area having a population of not less than 50,000, or in Ireland the Medical Superintendent Officer of Health of a county or borough having a population of not less than 50,000.

The examination consists of two parts, Part I and Part II. In each part all specified subjects must be passed at one time.

Part I is practical, written and oral in the subjects referred to in Rule 3.

Part II is practical, written and oral in the subjects referred to in Rules 4, 5 and 6. It will thus be seen that the curriculum is a very full and exacting one. Up till quite recently a certain number of officers were able to go up for this examination under the 1923 Regulations, having

started their studies prior to December 31, 1923. Now no officer will be able to do this who cannot produce satisfactory certificates that he started work for the Diploma of Public Health prior to the end of 1923, and these certificates must be approved in each case by the Examining Body.

With regard to Part II, it is impossible to state what certificates would be accepted in lieu of those referred to in Rules 4, 5, and 6, as each case would be judged on its own merits by the authorities concerned, and this also applies to the certificates referred to in Rule 3, as only certain laboratories are recognized.

The most serious obstacle to officers in the Royal Army Medical Corps is the fact that in order to sit for Part II they must obtain a certificate for six months' practical instruction in public health routine from one medical officer of health. It should be noted that a certificate from two or more medical officers of health is not accepted.

It would appear that under the new regulations the only officers who will have an opportunity of obtaining the necessary certificates will be those who specialize in hygiene, and possibly an officer home on long leave from the West Coast.

The Diploma of Public Health is granted by so many examining bodies that it is impossible to give details of them all in these notes. As in all cases the subjects required are more or less the same, and the courses of study must conform to the regulations of the General Medical Council, it is only proposed to deal further with the London and Cambridge Diploma of Public Health.

There are three examinations a year for the London Diploma of Public Health; Part I is held during the months of March, June and December, and Part II a few days later. The fees for the examination in each part is ten guineas (£10 10s.) except in the case of candidates possessing the Diploma of the Conjoint Board, when the fee is six guineas (£6 6s.). Examinations are held at Cambridge University twice a year during the months of April and September. The fee for the examination for either part is six guineas (£6 6s.).

A new series of regulations have been drawn up by Cambridge University which makes it obligatory to take out the full course of training for the Diploma of Public Health at the University itself. As far as it is known there is only one exception to this rule, which is the case of the Royal Army Medical College, which course of studies has been accepted by the authorities.

There is one great advantage in taking a Cambridge Diploma of Public Health, which is the fact that the Diploma of Public Health and the Diploma of Tropical Medicine and Hygiene are amalgamated in Part I, which is the same for both qualifications.

This is a decided advantage, as it allows a candidate to pass in Part I, and afterwards qualify in Part II, of whichever diploma he wishes to take, the usual tendency being to pass in both subjects.

Clinical and other Notes.

SOME OBSERVATIONS ON ORIENTAL SORE.

By Captain R. R. G. ATKINS, M.C.
Royal Army Medical Corps.

The following notes are the result of two years experience of this condition as met with in Mesopotamia.

The popular name locally for this affection is Bagdad boil. Different races of people appear to be affected in the same degree.

The means whereby infection takes place is not known. The literature on this subject suggests the probability of infection taking place through the medium of insect bites. The incubation period varies from a few days up to eighteen months.

In support of this statement the following two cases are quoted:—

Private X, an R.A.M.C. orderly, came to me one morning with a verbal message from our bacteriologist asking if he might have X-ray treatment for his Bagdad boils. On examining him I found three large boils on his forehead, one on his chin and one on his cheek. These resembled ordinary acute boils. He stated he had had them only a few days. I sent him back for confirmation of the message, remarking that they were much too acute for Bagdad boils. The bacteriologist reported that the *Leishmania tropica* parasite was present in every boil. It is conceivable in this case to imagine that the patient had been bitten by an insect and that the incubation period was short. Private X stated at the time that a few days previously he had wakened in the morning with irritable spots on the site of the boils. He put it down at the time to bites from some form of insect during the previous night. One cannot argue from a particular statement to a general one, but in this case I think the evidence is in favour of infection being caused by bites from the same insect, and that the incubation period was short.

On the other hand, I have known a Bagdad boil make its appearance eighteen months after the patient had left Mesopotamia, or any country where *Leishmaniasis tropica* occurs even sporadically.

Two clinically different types are met with: *Type I* is only seen in Lower Mesopotamia, whereas *Type II* is general throughout the country.

Type I.—A small purple nodule appears which slowly flattens out into a depressed ulcer containing in the periphery numerous other similar nodules.

There is no loss of epithelium. There is, as it were, an eating away of the underlying tissue, the epithelium being left intact. These ulcers are oval in shape; and *Leishmania tropica* can only be found in the nodules at the periphery.

Type II.—Is similar in appearance to an ordinary boil; there is loss of

continuity of epithelium. If these are left untreated and are kept dry they become covered with a hard crust which heaps up in the same way as a syphilitic rupia. It is more usual to find these sores multiple, but they do occur singly.

Treatment.—In *Type I* it is unnecessary to put on any local dressing. In *Type II* it is most important to keep the sore dry; a wet dressing causes it to become more inflamed and to spread rapidly. All cases were treated by irradiation with X-ray. It was found by experiment that although the majority of cases responded in some degree to any dosage of not less than half a Sabouraud pastille dose, the best results were obtained by doses which produced a slight bronzing of the skin. This is usually obtained by a slightly longer exposure than is sufficient to produce the full tint with the Sabouraud pastille. Care must be exercised as otherwise an X-ray burn may be produced. In all cases so treated no case remained bronzed for longer than fourteen days. If any sign of bronzing still exists in ten days' further irradiation should be postponed till the skin condition is again normal.

Technique of Treatment.—A tube of a penetration equal to four on Benoist scale was used, with a current of three M.A. I found that such a tube gave better results than either a harder or softer one. A filter of leather a quarter of an inch thick was used; it is important not to forget to use the same filter for the pastille which is measuring the dose. Doses were repeated at an interval of ten days, provided that as stated above there was no bronzing of the skin. Three doses were usually sufficient but improvement is often noticed after two. After the second dose ionization of the sores with zinc was commenced. In many cases this completed the cure, if not irradiation was continued.

In cases which have multiple sores it is not necessary to irradiate them all. If one or two are so treated, while they all receive zinc ionization, all the sores will heal at the same rate. This fact was noticed as the result of treating a series of cases with multiple boils, when the boils which had not been irradiated (owing to their number) healed as rapidly as those treated. The possible explanation of this fact may be that an auto-vaccination is produced as the result of the action of the X-rays on the *Leishmania tropica.*

I have seen one instance only of a person being twice affected with oriental sore. In this two-and-a-half years elapsed after the original sore healed. The second infection occurring as a breaking down of the scar on the site of the original infection.

Healing does not take place by the filling up of the ulcer with granulation tissue. The epithelium grows over the floor of the ulcer, leaving a shallow depressed cicatrix.

Nearly 250 cases were treated on the above lines with, on the whole, good results; only three or four cases failed to respond to this treatment. All other cases were cured within a varying time limit. It was only towards the latter end of this series of cases that heavy X-ray doses were

used, which, as already stated, give quicker results. The most important factor in the treatment is the X-ray tube. I believe that there is only a small limit of wave length with which to work in order to obtain the best results.

As the treatment of this condition stands at present, the method outlined above appears to give better results than any other.

A CASE OF DELAYED TETANUS.

The following copy of a report by Sir STEWART ABRAM, physician to Royal Berkshire Hospital, is published by the kind permission of the Director-General of Medical Services, Ministry of Pensions.

LIEUTENANT A. B. C. was admitted to the Royal Berkshire Hospital with the following history.

He was wounded in the left calf in April, 1918, as a result of a burst shell, and taken prisoner four days later. No A.T.S. was given. He has been continually under treatment by the Ministry of Pensions since his discharge from the Army. He states that the wound in the left calf has never fully healed, and that some foreign body has been discharged therefrom, probably a fragment of clothing. For the last year he has had occasional stiffness of the muscles of the left calf. There has been no other wound or injury to any part of the body since that received in April, 1918. Shortly before his admission to hospital in 1924, an autogenous vaccine was prepared by the Ministry of Pensions from the wound in the calf and forwarded to his doctor for injection. The first dose was given on May 14, 1924, and the second on May 21. On May 22 he noticed slight spasm of the lower jaw, on May 23 he had commencing trismus and the left leg was stiff. He was seen by his doctor and some A.T.S. administered.

He was admitted to hospital in the morning on May 24 with severe generalized tetanus with all the cardinal symptoms, well-marked trismus, and respiratory spasms. The wound on the calf was then covered with a dry scab. He was treated with large doses of A.T.S. intrathecally and otherwise, and after very severe illness recovered.

I am of opinion that Lieutenant A.B.C. had been suffering from slight localized tetanus as the result of the wound received in April, 1918, and that his tetanus was directly attributable to that, and that the determining and immediate cause of the onset was the injection of the autogenous vaccine, which set free or lighted up an infection which was latent until that time.

The above should be read in conjunction with the following report by the pathologist to whom the specimens were submitted for examination.

Two specimens were received for examination from this patient. No. 1, the vaccine, and No. 2 some shreds of drab cloth, which were removed from the wound near the ankle.

Both specimens were injected subcutaneously into mice in the back near the insertion of the tail.

Neither mouse during its period of observation, which was one week, showed any symptoms which could be in any way ascribed to tetanus.

Both mice were killed on the eighth day, at which time they were perfectly fit.

Post-mortem examination showed no abscess formation at the site of injection, and no signs of disease.

STOVARSOL IN THE TREATMENT OF AMŒBIASIS.

By Major J. HEATLY SPENCER, M.D.Lond., M.R.C.P., D.T.M. and H.Cambs.
Royal Army Medical Corps.

Some of the initial results of stovarsol treatment in intestinal amœbiasis occurring in Baluchistan are given in the following note. The trial could not be said to be entirely satisfactory owing to the great difficulty in obtaining supplies of the drug, for which reason dosage had to be limited to the lowest amount consistent with clinical improvement.

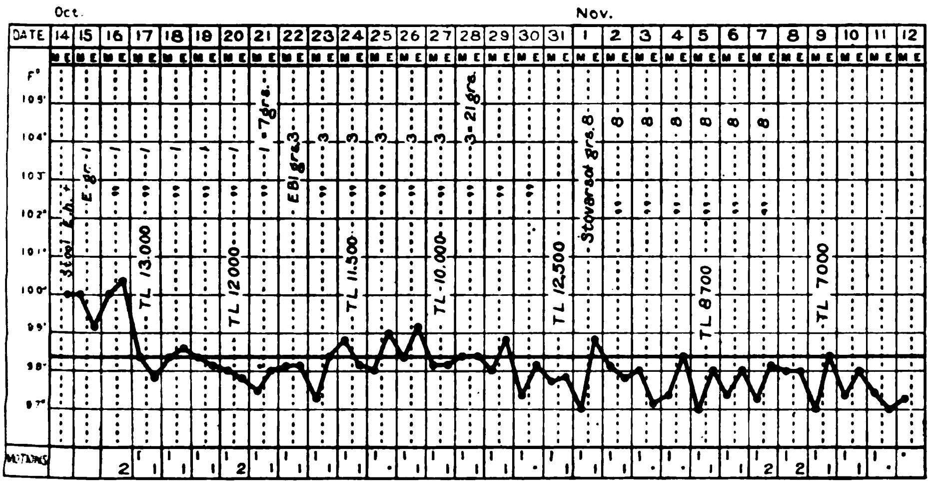
The first case treated was that of a serjeant, aged 38, who contracted amœbic dysentery in December, 1923, and after receiving six grains of emetin hydrochloride (no other treatment being available) joined the ranks of chronic cyst-carriers. This state of affairs, punctuated by intermittent attacks of diarrhœa, continued till February, 1924, when he applied for treatment. On examination he was found to be a cyst-carrier and was admitted to hospital. Treatment consisted of thirty-six grains of emetin-bismuth-iodide (spread over twelve days), all of which was retained, followed by four days of emetin treatment by enemata of the usual strength. The net result of this treatment was to produce amœbæ in the stools where formerly cysts only had been found. Stovarsol was then commenced and 144 grains spread equally over twelve days were given.

Tests were carried out on the fourth, seventh, fourteenth, and nineteenth days following cessation of treatment and were all entirely negative for *Entamœba histolytica* or cysts. Giardia cysts were found on the seventh day. The case has been free from all symptoms for six months, after which period the stools still contained Giardia cysts but no others of pathogenic nature.

Case 2 is that of a soldier, aged 25, whose clinical chart is reproduced. This man was admitted very ill with an amœbic hepatitis. The chart shows the persistence of a high leucocyte count while under emetin treatment and a rapid and striking improvement as soon as stovarsol was given, even in moderate dosage. The clinical improvement followed the fall in the leucocytosis.

Case 3 is that of a child, aged 2½, who contracted an amœbic dysentery

in March, 1924. Five days of treatment by injection of emetin ¼ grain daily failed to remove the amœbæ from the stools. Emetin was then stopped and stovarsol one grain per day given for twelve successive days, when the stools were found to be free from *E. histolytica* and cysts. Amœbæ reappeared ten days later and were finally removed by a further course of stovarsol, six grains. Since that time no further symptoms have occurred and the child's health has been entirely satisfactory.



Case 2.

Case 4 is one in which the effect of stovarsol was tried upon a child aged 6, whose stools were repeatedly found to be crowded with trichomonas Only twelve grains of the drug could be spared for this experiment. On conclusion of the treatment the stools remained free for one week from trichomonas, which then reappeared.

Case 5 is that of a child, aged 1, who was admitted to hospital. Amœbiasis was suspected for some time before laboratory evidence proved its presence. By this time the child was dangerously ill with high fever of an enteric type which continued for nearly three weeks. This case was treated by both emetin injections and stovarsol—the latter being given in a course of fifteen grains spread over a similar number of days. On completion of the stovarsol treatment the stools were found to be free from amœbæ and cysts and the child made a complete recovery.

The laboratory diagnoses were all carried out by Major A. Cave, D.S.O., O.B.E., at the Baluchistan District Laboratory.

Travel.

NOTES ON A VOYAGE FROM SOUTHAMPTON TO BOMBAY ON A TROOPER, H.M.T. "MARGLEN," 10,500 TONS (CANADIAN PACIFIC), JANUARY 23 to MARCH 17, 1923.

By Major A. D. STIRLING, D.S.O.
Royal Army Medical Corps.

In accordance with instructions I embarked on the good ship "Marglen" on the afternoon of January 23, and found quite a number of old friends who were to be fellow-passengers, so that I felt at home right away. Things were unsettled on the ship, as only part of the crew had joined, and the quay-side was covered with baggage which was being rapidly put on board by a fatigue party. We left the following afternoon about 3.30 p.m., and moved slowly down Southampton Water; on the way we saw three huge liners lying almost side by side—the "Berengaria," the "Mauretania," and the "Olympic." It was quite an imposing sight to see the huge leviathans towering over all the other ships, many of which are of quite respectable size.

As we passed Netley Hospital we had a hearty greeting from the staff who waved us Godspeed, and soon we were on our way to the channel and to the open sea. About 10 a.m. next morning we passed Ushant, and entered the famous Bay of Biscay, which was very much smoother than is usually reputed. (As a matter of fact in five different journeys I have never seen it rough.)

We indulged in the usual deck games for part of each day; deck tennis was the favourite. On the second day out (when most of the passengers had got settled down) we were allotted to boat stations, and had a practice alarm, when instruction in putting on and adjusting lifebelts was given. We had several practices during the voyage to ensure that no one would be caught napping.

On the third night out we had an excellent dance, arranged by the ship; the jazz band recruited from the stewards was very good indeed, and the deck looked very gay with bunting and Chinese lanterns. These dances were held regularly through the voyage—one night for the first and second class, and another night for the "Tommies." All were thoroughly enjoyed.

The weather had been dull and cold, but as we neared Gibraltar it was bright and quite warm. We arrived at Gibraltar on the 28th at 3.30, and stayed till after midnight, so that there was plenty of time to get ashore.

The next day was fine and we were quite close to the African coast.

On the following day we could make out Algiers, but the atmosphere

was rather misty, and in the evening the sea became rather rough, and there was a good deal of movement on the ship. On the 31st the sea was much calmer, and we were close to the coast of Tunis. At 10 a.m. next day, the 1st of March, we arrived at Malta, where we stayed until about 4 p.m. We had time to get ashore and see the main sights, none of which were new to me.

The night after leaving Malta a fancy dress dance was arranged by the ship, and a great success it was.

The weather was fine from Malta to Alexandria, which was reached about 11 a.m. on the 4th of March. It was brilliantly warm, and the expansive harbour looked very well as we passed the Ras-el-tin lighthouse on the way to the jetty where we were to be moored for the next sixteen days. We were allowed ashore right away, but were ordered to carry revolvers in case of any trouble arising over the question of the Sudan.

While at Alexandria I had the pleasure of seeing several old friends of pre-war days, with whom I had long chats over the changed situation in Egypt. One of these, Dr. Morrison, who has been at Alexandria since just after Arabi's rebellion, related several facts of interest which throw some light on the causes of the unrest that has been manifest since the war. He informed me that the day after the train murders in Upper Egypt (when a number of officers and other ranks were foully beaten to death with sticks and stones, without any provocation on their part) he was walking in the Nouzha Gardens, when he saw an old Copt of his acquaintance with whom he entered into conversation, and immediately asked what the meaning of these murders was: the Copt told him at once that the reason was as follows, viz., that it had been rumoured that some 120 British other ranks were coming out to fill vacancies on the Egyptian State Railways, and that the Egyptians would stand this no longer: they did not mind the higher positions being filled by the British, but they could not put up with subordinates filling posts which the natives in their opinion could fill to better advantage. The Copts, who are the better educated Egyptians, were formerly staunch supporters of the British rule.

Everything was quiet and peaceful while I was there and I could notice practically no change in the attitude of the native in the course of conversation and several went out of their way to be helpful. This was at the time when trouble was feared owing to the Turkish situation, and when the Egyptian Cabinet had resigned: Egypt, I should think, is about the only country that could carry on for so long without a cabinet.

Alexandria has grown considerably since pre-war days and the British population has largely increased; buildings have sprung up all over but the main thoroughfares looked dilapidated and not at all like a progressive city. At the docks there were a great many ships loading—chiefly cotton and cotton seeds. The vast majority of the cargo ships were British—City Line, Moss Line, Prince Line, etc.

While lying in harbour the "Samaria," one of the latest Cunarders, of

some 20,000 tons, with a crowd of Americans doing a world tour, came in and lay for three days alongside of us. All the passengers left the ship and went off by special train for Cairo and Luxor, being due to catch the boat at Port Said. They were paying some £4,000 for the trip, and according to all accounts were determined to miss nothing. I had, with others, an opportunity of going over the ship with two of the officers, and most interesting the visit was. She is equipped in the very latest style in every particular, is an oil-burner, and is designed to give a minimum of movement in rough weather; the chairs in the dining saloon are not fixed, which shows the confidence they have in the designer's work. The cabins are all de luxe, each with an ordinary window, which gives the effect of a room rather than a cabin. There are two winter gardens, one on either side of the ship, where one has all the advantages of being on deck, while at the same time being sheltered in cold weather. At night they are used for dancing to the music of two jazz bands.

I was informed that the passengers were not a very cheery crowd, and that they were rather prone to complain about trifles, even about the rain at Algiers. It was said that one of them put a £10 note under his plate for the steward every night; evidently he looked ahead and was determined to get good service for his tips.

A few days later the "Homeric," a White Star Liner (ex-German), of 35,000 tons came into harbour also with a crowd of trippers; she put off half of them at Alexandria, then went to Jaffa for Jerusalem with the others and returned a few days later to pick up the Cairo crowd. She was only doing the Mediterranean as on account of her size she could not go through the Canal. The "Samaria" on the other hand was going right on to India and Japan, etc., returning to America (New York) by the Panama Canal.

The weather at Alexandria was at first quite cold and one was glad to sit in the sun; later, however, there was a distinct change, and we had a slight foretaste of the weather to be expected in India.

We left Alexandria on the morning of February 21, and apart from rather a sudden severe storm in the Ægean Sea the voyage was uneventful, and we reached Constantinople on the 24th in the early morning, and the view was magnificent, the minarets being silhouetted in the morning light while the lower parts of the mosques were enveloped in a thick mist. We came to anchor just off Stamboul, in line with the famous Mosque of St. Sophia.

On the way up we had a good view of Cape Helles and some of the landing places of the original Gallipoli Force; we saw the wrecked and stranded ships used, and also the sad sight of the numerous wooden crosses used to show the last resting place of fallen heroes.

At the Narrows we had an excellent view of Chanak, which looked very peaceful; there was no sign of the Turkish hordes encamped around the village, but one could with glasses make out General Marden's

Divisional Headquarters and the building occupied by the field ambulance, whilst on a plain above one could see "Tommies" indulging in a bustling game of Soccer.

At Constantinople a service of motor launches was organized by Headquarters to allow us to go ashore to see the sights of the well-known city. Full advantage was taken of these and in addition General Harington sent his launch to take the first-class passengers in relays up the Bosphorus, while for the other ranks the "Water Witch," famous at Salonica Base, and capable of carrying nearly a battalion, was used.

I noticed many changes since my last visit in 1914, when all apparently was quite peaceful; the streets were crowded, doubtless with many Russian refugees, although it was not easy to distinguish them; in addition there were crowds of officers and soldiers, Turkish and Allied—British, French, Italian—and besides these there were naval officers of each nation, and of course other ranks—police of those nations belonging to the Allied Police Commission, and finally, representatives of the American and Spanish navies, so you can imagine the types to be seen on the streets and on the cars, of which there is quite a good service.

Constantinople is in three distinct sections: Stamboul, the old city to the south and separated from Galata and Pera by the well-known Galata bridge spanning the Golden Horn. Galata is spread along the water side and it is here that the ships berth; there is really no proper harbour, and the larger vessels have to anchor out in the stream.

The most noticeable building on this side is the Galata Tower, which projects above all others and is used for signalling, as a lookout for fires, etc.; from the top one can get an excellent view of the Golden Horn, the Bosphorus and the Sea of Marmora.

Pera rises steeply above Galata and is much more European, having quite passable shops in the main street—the Grand Rue de Pera.

The whole place is very hilly and there are some very quaint little streets to be seen on the way up: one curious one is Step Street, well described by its name, and rising steeply has long rough cobbled steps, with shops on either side.

Trams run from Stamboul across the bridge and up the hill to the principal centre in Pera, called Taxim; on the way up one passes the principal banks in the Galata part, a little higher the British Parcel Post Office, the French Post Office, the Pera Palace Hotel (the principal one), a little higher is the British Embassy, which is very nicely situated, looking over the Golden Horn. At the corner of the Rue de Pera is the Turkish Post Office, and further on the Tokatlian Hotel, also very well known, and then comes Taxim; here the Allied and British General Headquarters are situated near the Jockey Club, which is now used as an officers' club. The Headquarters are well installed and give one the impression of semi-permanency.

In a street with a steep descent to the right from Taxim one comes

first to the German Embassy, a fine building adorned with a plentiful supply of eagles, and looking over the Bosphorus, but rather desolate in appearance. Farther down one comes to 87th Field Ambulance and then 82nd General Hospital located in a large building which was very badly damaged by fire last year. This also has a fine situation looking over the Bosphorus.

The whole of this side is very hilly and very irregularly built with houses, mainly wooden, dotted all over the place; some of the newer houses are built of cement and though not very high give one the impression of American skyscrapers, as they are built on waste ground, are narrow and have four or five storeys. Apparently the two main risks are fire and earthquakes, and as fires are so common the natives prefer to take the risk of them rather than that of the earthquakes and so stick to the wooden buildings. For the most part the city is very dirty and there is nothing of much interest except the situation, which is certainly unique.

At Stamboul, however, there is a good deal of interest if one had time to study it thoroughly. The mosque of St. Sophia is perhaps the most interesting feature, as it is the sole Christian church used as a mosque, without being entirely changed. Since Constantinople was captured by the Turks, in 1453, they have done their best to efface all traces of Christianity from the interior of the building, painting out crosses and such like and putting daubs of gold paint over the faces of angels on various pillars; but curiously enough all these still stand out very clearly, and no doubt the Turk finds it useful and profitable to leave some trace for the benefit of tourists.

The building is very handsome, most of the interior being in marble. On the walls much of the marble is black and on it are to be seen natural pictures of devils, eagles, frogs, and so on. In the marble of one of the pillars there is a deep hole large enough to admit a finger; into this the faithful come and place their fingers and then rub their faces; this is supposed to heal them of all diseases, and it was started in Christian times and is still kept up; the hole is perfectly smooth and about three inches deep which gives an idea of the number of times it must have been used.

There are some beautiful old blue tiles and fine handsome mosaic which are well preserved.

There is a large urn near the exit carved out of solid marble containing drinking water which it is the custom to drink after prayers.

On the pillars under the dome there are large plaques enamelled in black on which are emblazoned in gold the names of various caliphs. The floor is covered by hundreds of praying mats of fair quality but well worn.

At the gates there are the usual beggars (in this case young females) asking alms.

Quite near the Mosque there is an old palace with wonderful under-

ground lakes, large enough to allow of boats being used; out of the water rise the pillars supporting the palace, now disused as such; the pillars are of different styles of architecture, some plain and some with Corinthian capitals. Doubtless the explanation of the lakes is that when they started to build the foundations they came on a spring, but still carried out their original plan. The water is at a fixed level so that there must be a continuous outflow.

Continuing to the west one comes to the residential Turkish quarter, with the various Ministries to the right, overlooking the Golden Horn; a little farther on and to the left one arrived at one of the royal turbehs, or mausoleums, which, as sultans are shortlived and each possesses a regiment of wives and children, are dotted all over Stamboul. This turbeh was very interesting; naturally, one had to put on the obligatory slippers before entering. The tombhouse was rather small, hexagonal in shape, with gilt grated windows through which the sunlight was streaming, and with fine carpets on the floor. The biers are closely packed together; these are simply catafalques of wood raised on supports and covered with the finest Persian and oriental shawls. Those of the Sultans are much higher than the rest and are distinguished by a turban of rich stuff at the head. In some cases they were surrounded by a railing of ebony inlaid with mother of pearl. That of Sultan Abdul Hamid (of which I managed to get a photograph) was covered by a beautiful green silk cloth with embroidery and writing in gold.

In this turbeh was a handsome modern-looking chandelier in crystal, which our guide (a Greek born in Stamboul who was formerly one of the guides for St. Sophia, a province now reserved exclusively for Turks) said had been given by Queen Victoria; there was also a beautiful gold clock said to have been given by Napoleon. There were also very fine copies of the Koran done on parchment with writing in black and gold; one special one had been prepared at Baghdad and had characters in both Turkish and Arabic writing.

Close to this are the bazaars which are under cover and form quite a town by themselves; there, all sorts of Eastern specialities can be had—amber goods, embroideries, gold and silver work, carpets from all over the East; but shortly it will be impossible to obtain any but Turkish carpets there as recently the Turks have brought in a law prohibiting the import of foreign carpets; in addition all sorts of articles in daily use can be had.

We lunched at an Armenian restaurant where the fare was very good, though the prices were very high for the locality.

One afternoon we went up the Golden Horn to Eyoub (Job ?), a place of historic interest named after the friend and standard-bearer of the Prophet, who was killed in the year 668 at the first siege of Constantinople. It is a most picturesque suburb beyond the walls of Stamboul, and surrounded by woods and cypress groves. This was a most important place for the Greeks, and here each new Basileus was presented to the army

and proclaimed Imperator. The Turks carry on a similar ceremony called the sabreing of the Sultan, but it has become much less imposing in recent years, owing to the Sultan's continual dread of assassination. The mosque at this place became the chief mosque of the Ottoman Empire, the scene of the great ceremonies of the Moslem faith, and was never visited by a foreigner or Christian before the war. It is said that if any foreigner was discovered there during one of the ceremonies he forfeited his life. During the day in ordinary times the landing place (it is situated on the Golden Horn) was guarded by an armed sentry, as was also each end of the thoroughfare which runs through the village. The sentry was there when we approached from the jetty, but he made no objection to our entering. Here also there are famous turbehs of distinguished Turks, exactly similar to those already described at Stamboul.

One passes through the courtyard of the mosque to get to the village, which is very small, and consists of one long lane with rather primitive shops and only a few short side turnings. In the shops the most noticeable feature was the number dealing in fish, which looked very fresh and quite tempting.

In a square inside the grounds of the mosque there were a number of stalls on which were displayed old chaplets of beads of various sorts, old books, little bottles of all kinds, with glass stoppers, containing perfumes, the whole lot sorted out with untidy regularity; these were presided over by decent looking old Turks, who did not press their wares but were quite ready to come to a bargain. When a purchase was made the purchaser (and friends) had a drop of perfume placed on the palm of the hand as a sort of backsheesh.

On the way back from the village we were invited by a Turk, clothed in a flowing robe of dull cherry colour and wearing the usual fez, to enter the mosque, where a full service was in progress. The Turk had rather a pleasing face and he immediately started to rake out all the slippers available so that we might conform to the usual custom of donning them before walking on holy ground; obviously the place was not much frequented as he had considerable difficulty in getting the requisite number of slippers (we were a party of about ten) and some of those produced were holed so that the object was not attained.

It was most interesting to see the mosque full of people, both men and women, the latter in special enclosures, screened off from the body of the mosque. The whole assembly went through a series of movements with military precision; standing quite erect, then kneeling, then throwing themselves to the ground face foremost, following the recitation of the Koran by a Sheikh who occupied a sort of raised pulpit at the back. One or two late comers rushed in between the recitation of the various passages, having removed their shoes, which they deposited in long wooden trays stretching across the floor of the mosque. The whole thing was most impressive.

The village and surroundings were very quaint and old-world looking and well worthy of a visit.

We finished the afternoon by going up towards the Sweet Waters of Europe as far as we could in the launch at our disposal; the scenery calls for no special comment.

I have tried to give a slight impression of what I saw during my stay at Constantinople and the neighbourhood, and for one or two of my facts I have referred to the diary of an "Idle Woman in Constantinople," by Frances Elliot.

We left Constantinople late in the afternoon in a very heavy shower of rain, just as the "Mauretania" came in with a crowd of tourists, mainly from America. They were giving a dance on board that night to which officers of the Allied Forces were invited. We were naturally very sorry to be unable to take advantage of their kind invitation.

We stopped at Killia on the way down to put off details, and then steamed at a good speed to Port Said, where we stopped long enough to coal.

The journey through the Canal and Red Sea was fairly warm but fortunately we had a strong head wind in the Arabian Ocean which made things comfortable.

In the Suez Canal, or rather in the lakes, we passed close to the "Laconia," a Cunarder, which was doing an Eastern cruise, and she looked very smart; most of the passengers as usual were American and as they looked over the side they seemed very interested to see a British troop-ship with a full complement—the decks packed with "Tommies" all in very good spirits.

There was nothing else of special interest until we came to the vicinity of Aden, and then we saw a great many small Arab dhows laden with stores and coloured humanity making for the African coast. They did not look very seaworthy and I should not have cared to risk a voyage in any one of them. For all one knows, some of them were engaged in slave traffic, which is still said to exist in these parts.

On approaching Aden we saw the well-known "barren rocks of Aden," and very desolate they looked; soon we could see the signs of shipping in the harbour and gradually the buildings and military hutments became quite clear. The ship made a big sweep round to enter the harbour and we steamed slowly in, so that we got a very good view of the place, which did not look at all attractive; there was practically no green to be seen and the impression that one formed was that it must be very hot and dusty.

The Australian mail boat, the "Orsova," was in the harbour when we entered, and she left a few minutes later, so that we just missed the mail by a matter of seconds. We stayed only a very short time, so that we did not get ashore: we were surrounded as usual by a swarm of natives in tiny canoes and other small craft selling their various wares, which in this instance included such things as sharks' jaws; one old Arab had his little

boat full of them, but he did not do any business while we were there. One of the merchants was a tiny little imp of a boy, looked like a child of five, in quite the tiniest and narrowest canoe I have ever seen.

The passage across the Arabian Sea was uneventful but very pleasant; as we neared Bombay a stickiness in the air was noticeable and this was much worse when we got close in; we could see the main buildings from a long way out, and the view as we approached was very fine. Malabar Hill, covered with green trees, looked very well; this is a fine residential part where many wealthy Parsees live, and here also are the Towers of Silence where the Parsee dead are exposed to the four winds for the vultures to dispose of—a custom that strikes a new-comer as very strange, but India is a land full of strange religions and habits. The Taj Mahal Hotel is also a very prominent feature on the landscape, while the Colaba Military Hospital stands out on the point so that it gets full benefit of the sea breezes.

We arrived in the harbour on the evening of March 16, and soon after got news of destinations and also a long looked-for mail, which was a very good one and needless to say very welcome.

Next morning we disembarked and a very pleasant and memorable voyage of over fifty-three days came to an end. By evening the majority of the passengers were on their way up country and the ship's complement scattered in all directions.

Such is an episode in a soldier's life!

Current Literature—Surgery.

Extract from an Article on Duodenectomy. By Charles A. Pannett, London (published in the *British Journal of Surgery*, October, 1924).—It is now generally accepted that the direct surgical treatment of chronic ulcers of the stomach is vastly more satisfactory than the indirect procedure of gastro-jejunostomy. For some years it has been felt, especially in continental clinics, that the results of indirect surgical treatment of duodenal ulcer left much to be desired.

The question therefore arose as to whether better results could be obtained from the direct surgical procedure of excision of duodenal ulcers than by gastro-jejunostomy as usually practised.

Between 1916-21 the operation of excision was practised by certain continental surgeons, and a series of 236 resections with a 3·4 per cent mortality was published by Finsterer.

Before proceeding to a description of the technique of the operation the author directs attention to the following pathological points. First, extensive fibrosis around the ulcer is usual, which renders the common bile

and pancreatic ducts liable to injury during the operation. The second point is that frequently more than one ulcer is present.

Technique of Resection.—A right paramedian rectus sheath incision gives best access to the site of the operation. If owing to extensive fibrosis it is found impossible to keep clear of the common bile duct, or if the ulcer appears to extend to the common duct papilla, the operation of resection should not be proceeded with.

If neither of these contingencies exists, the attachment of the great omentum is divided just below the pylorus and the lesser sac opened. The lesser omentum is incised just proximal to the pylorus, and a sling of gauze passed round the pylorus as a tractor.

Next the border of the duodenum continuous with the greater curvature is freed, every vessel being ligatured, and if possible a ribbon of gauze placed between the pancreas and the duodenal wall distal to the ulcer.

The attachment of the gastro-hepatic ligament to the stomach is severed and the pyloric artery ligatured and divided.

The common bile duct is then defined, keeping close to the duodenal wall and working with great caution. The stomach is divided between clamps just proximal to the pylorus. The duodenum is turned to the right and separated from the pancreas, ligaturing every vessel before dividing it. On reaching healthy bowel it is clamped and cut across.

The duodenal clamp is then rotated so as to expose the posterior surface, which is applied to the stomach and an axial union carried out in the usual manner.

The disadvantages of the operation are its length and tediousness, which are inevitable.

The chief dangers are injury to the pancreatic and bile ducts.

Whether resection as described above should displace gastro-jejunostomy as the recognized treatment for duodenal ulcer or not, is at present a moot point, and one that can only be decided after the operation has been given a more prolonged trial.

At the end of the article are published notes on nine cases in which the author had performed the operation of duodenectomy, in all of which the immediate results were satisfactory. H. C. S.

Submaxillary Salivary Calculus. By Hamilton Bailey (*British Journal of Surgery*, October, 1924).—In this well illustrated article the author presents a clear and comprehensive account of the symptoms, differential diagnosis and treatment of the conditions arising from submaxillary salivary calculus.

The ætiology of the disease is obscure, and although cases are from time to time reported where a foreign body has been found as the nucleus of the calculus, the majority of cases have no such simple origin. It would appear more likely that the consistency of the saliva excreted

by the submaxillary gland, which is thick and of a mucoid nature, is more responsible for the formation of these stones. This theory is supported by the fact that calculus formation is very much more common in the submaxillary gland than in the parotid gland, the saliva from which is thin and limpid. The disease is far more commonly found in males than females, and may occur at any age between 16 and 65.

The symptoms produced by calculus vary considerably, and in many cases the presence of stone is only manifested by X-ray films that have been taken on the presumption that the pain, which is generally described as toothache, is caused by carious teeth. When pain does occur it is almost always at the commencement of a meal, due to the increased excretion of saliva and the difficulty or inability for it to pass along Wharton's duct owing to the blockage caused by the calculus. The pain is often referred to the tongue, which is explained by the close apposition of the lingual nerve to Wharton's duct. Swelling of the submaxillary gland, which varies in size in relation to meals, is described by the author as pathognomonic of the condition.

Details of the dry swab and salt or lemon juice on the tongue method of examination are given, and the author lays considerable stress upon the necessity for bimanual examination, by which method only can the whole gland be properly examined. Emphasis is also laid upon the value of X-rays in diagnosis, especially in those cases in which the stone lies in the posterior third of Wharton's duct; at the junction of the duct with the gland; or in the gland itself, and in these cases the lateral X-rays is the only one of any value. X-rays will also provide the readiest method in differential diagnosis of calculus from such conditions as peridental suppuration, cervical lymphadenitis and malignant disease of the submaxillary gland, all of which without its aid may be mistaken for calculus. It should also be noted that even when one or more calculi are visible or palpable, a radiogram should always be taken to prevent the presence of other stones in the gland itself being overlooked. Occasionally secondary infection takes place in a case of calculus, and when this becomes severe it may stimulate acute glossitis or Ludwig's angina.

The treatment of salivary calculus depends to a great extent upon the position of the calculus. Where there are no symptoms of blocking of the duct and the stone is very small, it may be feasible to try expectant treatment with mouth washes, in the hope that the calculus will be naturally expelled. The progress should be watched with X-rays. In all other cases the choice lies between (1) slitting up the duct under local anæsthesia; (2) grasping the stone with toothed forceps, incising the duct and removing the stone; or (3) in cases of multiple calculi in the gland, old-standing obstruction of the duct, chronic and persistent inflammation in the gland, or stricture of the duct in which dilatation fails—extirpation of the submaxillary gland should be undertaken. In the author's series of cases removal of the gland gave excellent results, no recurrences took place

in the remaining glands, and the patients suffered no inconvenience from its absence. The operation is performed most readily through an incision as for ligature of the lingual artery. A. G. W.

The Sectional Plaster of Paris Casing, with Reference to the Treatment of Fractures of the Leg and Ankle. By W. A. Cochrane, of Edinburgh, in the *British Journal of Surgery*, October, 1924.—This article describes the treatment of fractures with plaster of Paris casing as an alternative method to splinting, and the author recommends that the plaster-casing should be applied to the lower limb in three sections.

For a fracture with displacement in the region of the ankle-joint a plaster case is first applied to the leg from a point two fingers' breadth above the ankle-joint to the middle of the thigh, while the knee is flexed thirty degrees.

A second plaster is then applied to the foot, but leaves exposed the ankle-joint area. When the first and second plasters have set an anæsthetic is given and the surgeon reduces any displacement of the fractured bones by grasping the first and second plasters and moving them in the required direction. While the surgeon holds the limb in the corrected position, an assistant applies a third encircling plaster round the ankle area, the foot being kept dorsiflexed and inverted. The third plaster unites the first and second plasters, and when it has set the whole case is bivalved for the subsequent treatment of the limb by massage. Special attention is drawn to the protection of the limb by suitable padding and bandaging before the plaster is applied.

The author claims that the fractured bones can be retained by this method in the correct position and that recurrence of the deformity is much less likely to occur than when the ordinary back and side splints are used for the treatment of these injuries.

A description is also given of the method of treating fractures of the leg adopted by Dr. P. D. Wilson, of Boston.

Dr. Wilson applies the plaster-casing in three sections as described above, but exerts traction on the fractured limb while the plaster is being applied in the following manner :—

The patient is anæsthetized and his buttocks are drawn towards the lower edge of the operating table. The sound limb is supported on a chair while an assistant holds the fractured limb in his hands.

The ankle being well protected from pressure, a clove-hitch loop of bandage is passed round the ankle and the two ends of the bandage are knotted round the hips of the assistant. The patient's knee is bent to a right angle and a loop of broad flannel bandage is passed round the flexed thigh about four inches above the knee-joint. Counter traction is then exerted by a second assistant holding the ends of this bandage, at the head end of the operating table. The plaster of Paris casing is applied and allowed to set while traction is exerted on the fractured leg.

A method of correcting angular deformity of the fracture after the plaster has set is described as "wedging."

For this purpose a window is cut in the plaster on the side opposite to the angular projection of the fractured bone, and using the uncut portion of the plaster as a hinge, the deformity is reduced.

Pieces of wood are then let into sockets cut in the plaster to maintain the corrected position, and finally the cut and wedged portion is encased with a fresh encircling plaster bandage.

The sectional method of plaster-casing described by the author should prove invaluable for fractures in the region of the ankle-joint which exhibit signs of recurrent displacement. C. C.

Prognosis in Acute Appendicitis.—In the October number of the *British Journal of Surgery* Mr. R. J. McNeill Love emphasizes the importance of considering each case of appendicitis on its merits, and of not subjecting each case to immediate operation as soon as the diagnosis is made.

He agrees that all early cases—generally those of less than thirty-six hours' duration—in which the infection is limited to the appendix itself should be operated on immediately.

Statistics show that the mortality from operations performed between the third and fifth days is high. This is accounted for by the fact that the patient has lost his natural immunity to the infection, and has not developed an acquired immunity. For this reason an attempt is made to tide the patient over this period, and operate later. If, on admission to hospital, it appears probable that the appendix has perforated, or that there is local peritonitis, "delayed" treatment is instituted.

The patient is placed in Fowler's position, and only water is given by the mouth. A careful watch is kept on the temperature and pulse. It is found that over 70 per cent of cases subside, and can be operated on a fortnight later.

If the case does not show signs of subsiding within twenty-four hours it is operated on; statistics show that this delay has not made the prognosis less favourable.

If a localized abscess forms while delayed treatment is being carried out, and if it does not show signs of absorption, it may be evacuated under gas.

Delay is also recommended in cases of general peritonitis.

Local collections of pus, if they form, may be evacuated later with comparative safety.

An interesting comparison is that of acute cellulitis of a limb with acute general peritonitis. Formerly both were treated by multiple incision and drainage—now the tendency is to wait for localized suppuration, and then open the abscess. P. O.

The Repair of Large Abdominal Herniæ by Muscle Transplantation. By Kenneth Mackenzie (*Brit. Journ. of Surg.*, xii, No. 45, July, 1924). —In the above journal Kenneth Mackenzie draws attention to a new method of dealing with large abdominal herniæ. Where the defect in the abdominal wall is too great to get sound tissues in contact, various devices such as the filigree or transplantations of fascia lata have been tried, but in many cases prove unsatisfactory.

The author cites a case of a massive hernia in the left lower quadrant of the abdomen which followed a septic gunshot wound and prolonged fæcal fistula. The patient was a bad subject for any operation as he suffered from chronic bronchitis with much cough. To close the very large gap the tensor fasciæ femoris was utilized.

The reasons advanced by the author for employing this muscle are:—

(1) Its upper attachment to the spine of the ilium is small and it is easy to swing the muscle.

(2) The nerve and blood supply enter the muscle high up and near the centre of swinging and are but slightly stretched in the new position.

(3) The loss of the tensor fasciæ femoris does not seriously affect the limb.

After closure of the peritoneal cavity the tensor fasciæ femoris was dissected out with a margin of fascial tissue of about one-and-a-half inches at either side and the lower end. When swung into position this fascial fringe overlapped the abdominal fascia by fully an inch. In spite of a little infection of the wound an excellent result was obtained. After a month electrical stimulation was employed and after four months the abdominal wall was sound.

The author suggests that in cases of advanced inguinal hernia and for large post-operative herniæ in the mid-line below the umbilicus that the tensor fasciæ femoris on both sides might be employed and the whole abdominal wall braced up. J. W. W.

Hernia following Appendectomy. Leigh F. Watson (*Chicago Medical Recorder*, March, 1924).—The usual causes of this hernia are post-operative suppuration in the abdominal wall; the use of drains that are larger than necessary; a faulty closure of the muscle and fascia layers; the division of nerves supplying the muscles; and the use of the wrong incision. The McBurney incision gives the lowest percentage of post-operative hernias.

An elliptical incision should be used if the sac is thin and adherent to the skin; if the sac is not adherent, a vertical incision saves time. Nothing is gained by opening the fundus—the adhesions here often make it difficult or impossible to reach the neck of sac—and time is saved by beginning the dissection at the neck and working inward. The author found that the simplest method of exposing the hernial opening is to invert the sac on one or two fingers and feel the sharp fascial edge which

is usually most distinct on the outer side of the hernia near Poupart's ligament. With the finger as a guide, the incision is made directly down to the fascia. The abdominal wall should be reconstructed as well as possible, and the muscles and fascia used as a single flap which is brought down and broadly overlapped by a second flap secured below from the external oblique aponeurosis.

"**Chronic Intussusception.**" By J. Gaymer Jones. (*British Journal of Surgery*, October, 1924.)—In this article the author shows that chronic intussusception—though rare compared with the acute variety—is nevertheless a very definite clinical condition. His observations are based on sixteen cases occurring in Guy's Hospital between the years 1900 and 1924.

The commonest exciting causes are tumours, innocent or malignant. Rarer causes are ulcers, Meckel's diverticulum and tuberculous peritonitis. In some cases no exciting cause can be found.

The average age incidence is between 20 and 40, but cases have occurred in infants, and those associated with malignant tumours occur in the latter half of life.

Primary cases usually start in the ileo-cæcal angle. Cases due to tumours occur anywhere where such tumours are found.

The following signs and symptoms are important :—

The onset is sudden with acute griping pain, and possibly vomiting. The spasms of pain are typically intermittent, and are increased by the taking of food. There may be long intermissions, for months or even years. Spontaneous reduction probably occurs in such cases.

Some irregularity of the bowels is usually noticed, but blood and slime in the motions are not a feature of this type of intussusception.

Wasting is a very marked characteristic, especially when cases occur in children. It is due to the pain and loss of sleep.

As regards physical signs, a "sausage-shaped tumour," disappearing on examination, is practically diagnostic. The tumour is slightly movable and tender; it may be felt to harden and then relax. It is sometimes hidden under the costal margin. An abnormally empty right iliac fossa may be demonstrated in some cases.

On rectal examination the apex of the intussusception or a growth may be felt.

Opaque meals are not much help, as there is but little obstruction.

In the adult, chronic intussusception has to be distinguished from (*i*) appendicitis with tumour formation; (*ii*) carcinoma of the cæcum; (*iii*) ileo-cæcal tuberculosis; (*iv*) a distended gall-bladder.

The following points should help to differentiate :—

Inflammation round an appendix will be more fixed. The pain during the acute stage is continuous and not spasmodic.

In (*ii*) and (*iii*) there is no sudden onset with acute pain in the early

stages of the disease. The character of the tumour does not vary from time to time.

The pain of a distended gall-bladder is more prolonged, and is usually accompanied by pyrexia.

In children, the tumour may be mistaken for the rolled-up omentum which is felt in tuberculous peritonitis, or for the hæmorrhage into the bowel which occurs in Henoch's purpura.

When no tumour is palpable chronic dyspepsia and chronic colitis may simulate the condition. The history of sudden onset will be absent.

Whether an intussusception will be acute or chronic depends on the degree of interference with its blood supply. The important factor is the length of mesentery available for invagination, or the ease with which a mesentery can be formed from the parietal peritoneum.

The treatment is early operation and reduction, as soon as the condition is diagnosed.

Disappearance of the tumour in an adult does not contra-indicate operative treatment. Intermissions are common, and the underlying cause may be a malignant growth.

Reduction is usually easy, but should adhesions prevent it, excision is the best treatment.

Drastic purgatives are dangerous, since they may precipitate an acute intussusception.

Sixteen actual cases are quoted, which bring out all the points emphasized in the above article.

D. J. B.

Reviews.

LORD LISTER. By Sir Rickman J. Godlee, Bt., K.C.V.O., M.S., F.R.C.S. Third Edition, revised. Oxford: The Clarendon Press. 1924. Pp. xvi. + 685. Illustrated. Med. 8vo. 21s. net.

This is the third edition of a memoir which appeared originally in 1917, and is by the nephew of the great master to whom we owe so much in modern surgery. To those sufficiently old, like the reviewer, to have taken a part in the full ritual of the antiseptic operations performed in the late seventies and early eighties of the last century the book revives many memories; to the younger generation the volume should be of prime interest as it traces step by step the evolution of a principle which underlies the whole of the art and science of surgery in which they have been trained. To the readers of this Journal the memoir should appeal greatly, because it focuses attention upon the circumstances and experiences in the late great war which came as a shock to the leading surgeons of 1914-1915, and compelled them to revise their confidence in the asepsis on which they

relied and in which they had been reared and revert to the principles on which Lister had worked fifty years before. The virulent infection which characterized and was the almost invariable sequel of the gunshot wounds of the early part of the war made men alarmed, made surgeons think, and compelled them to examine the early papers of Lister on compound fractures. The lesson was learnt and, after knowing nothing of the rubbing of wounds with pure carbolic acid and the various pastes which Lister tried or the various antiseptic solutions with which he attempted to sterilize infected wounds, the surgeons realized the value of direct attack on the septic areas by methods familiar to us under such terms as "Carrel-Dakin," "Bipp" and "free-excision." It is curious that Sir Rickman Godlee makes no mention of "Bipp" in his new chapter entitled "Postscript 1924."

We commend the volume to every surgeon, as the subject of the memoir is pre-eminently worthy, and the manner of representing his life and work peculiarly sympathetic and scholarly.

R. H. F.

AIDS TO SURGERY. By J. Cunning, M.B., B.S., F.R.C.S., and C. A. Joll, M.S., F.R.C.S. Fifth edition. London: Baillière, Tindall and Cox. Pp. viii + 434. Price 4s. 6d.

This is the fifth edition of Cunning and Joll's "Aids to Surgery." First published in 1904, the book has run through five editions and twelve reprints in two decades. This demonstrates its usefulness and popularity among students. The new edition has been revised and brought up-to-date by the second of its authors, while it remains in its former dimensions. It is designed with the intention of supplying the information that the student requires and, naturally, everything is epitomized: if he cannot carry knowledge in his head, he can at least carry it in his pocket at a cost of 4s. 6d.

M. B. H. R.

HANDBUCH DER TROPENKRANKENHEITEN. BAND III. MALARIA UND SCHWARZ WASSERFIEBER. By Professor Dr. Hans Ziemann. Leipzig: J. A. Barth. 1924. Pp. xiv + 592. Price £1 16s.

This book contains a very complete and practical exposition of the latest theories of malaria and blackwater fever, illustrated by the author's own very considerable practical experience.

After a preliminary discussion of the history and distribution of malaria, a chapter is devoted to the morphology of the parasite. It contains an interesting section describing the author's method of cultivating this organism, but he has never succeeded beyond three generations and is doubtful whether it can be cultivated further. The chapters on the natural history of the anopheles, on the incubation period and epidemiology of the disease do not add much to one's knowledge. As regards staining methods the author describes a modification of the Romanowsky, devised by himself,

which he considers superior to any other. The chapters on the clinical features, pathology, complications and sequelæ of malaria do not contain much new material. Of the two methods of determining the malarial index of a district the parasite index is considered more reliable than the splenic index, but of course demands more highly trained personnel. The author's demands on the pathologist for information as the result of a blood examination are higher than is usual in the service. Not only the variety of parasite should be determined but the time when the next attack is due, and whether it is a fresh infection or a relapse (presence of gametocytes in the latter case).

Both therapeutically and prophylactically quinine is considered to be decidedly more effective in large single doses than in multiple small ones, fifteen grains being the unit for benign tertian and quartan, and thirty grains in two doses for malignant tertian. The scheme of treatment advocated for benign tertian and quartan is as follows:

While fever lasts, 2-3 hours before attack is due, 15 grains; for 8 days after temperature normal, 15 grains; 2 days, interval; 2 days, 15 grains; 2 days, interval; 2 days, 15 grains; 6-8 weeks, twice weekly, 15 grains.

For malignant tertian the dose is doubled until eight days after the temperature is normal, afterwards the dosage should be continued as for benign tertian.

For quinine resistant strains the administration of neo-salvarsan in addition to quinine is advocated. It should be given intravenously at intervals of seven days, commencing with 0·3 gramme and reaching 0·6 gramme at the third dose; 6 doses are the average number but 7 or 8 may be necessary. Both for intramuscular and intravenous injections the importance of sufficient dilution is stressed, it should not be less than 1:10 and preferably 1:20.

The author speaks favourably of quinine prophylaxis. He claims to have been most successful with fifteen grains twice a week. For hitherto uninfected persons he prefers 5 p.m. as the hour of administration as fresh infections are more likely to occur at night, for already infected cases 10 a.m., as relapses occur more frequently during the day. Other prophylactic measures are discussed at length. The value of papaw trees (*Carica Papaya*) as driers of soil is mentioned.

Blackwater fever is defined by the author as an acute hæmolysis, for the production of which two factors are necessary: (1) a predisposition caused by malaria of more or less long standing, usually insufficiently treated by quinine, and (2) an exciting cause which may be one of four things: (*a*) acute malaria alone, (*b*) acute malaria plus quinine, (*c*) quinine alone, (*d*) some lowering of the bodily resisting power, e.g. cold. The author claims that all cases can be put under one of these headings. As to the method of production of the hæmolysis the author considers three possibilities: hæmolysins in the serum, hæmolysins in connexion with the red corpuscles, quinine itself acting as a hæmolysin, only to dismiss all three

and to conclude that the exciting cause is the combination of quinine (or some other factor) with some constituent of the body. Here again are two possibilities: (1) that the combination may interfere with the production of antihæmolysins, or (2) that it may itself directly produce hæmolysins, and of the two the author inclines to the second. The possibility of blackwater fever being a katalytic process or an anaphylactic one is also considered. The final chapter is a practical exposition of the therapy of blackwater fever.

In conclusion, the book contains no startling new theories but is a complete compendium of present-day knowledge of malaria and blackwater fever, and may be profitably studied by any one desiring a thoroughly up-to-date book of reference. J. A. B. F.

CLINICAL LABORATORY METHODS. By Russell Landram Haden, M.A., M.D., Kansas City, Kansas, U.S.A. Second Edition. London: Henry Kimpton, 263, High Holborn, W.C. 1924. Price 18s. net.

"Clinical Laboratory Methods," by Russell Landram Haden, has entered on its second edition. The work has been thoroughly revised and enlarged: it contains fourteen chapters dealing with clinical methods, serological, bacteriological, pathological and histological technique, and a short chapter on the examination of milk and water.

The text is thoroughly accurate in what it describes. The chapter on serological methods is very good. The Kolmer-Wassermann test for syphilis is clearly elucidated. The Van den Bergh test for bile pigments in blood serum, the creatinin test for renal function and the phenoltetrachlorphthalein test for liver function, all modern innovations, are adequately dealt with.

The descriptions of the various procedures are clearly and shortly written, and there is no reduplication. The book is clearly and profusely illustrated and includes four coloured plates, numerous useful tables, and a very complete index.

The volume is essentially practical and should not be regarded as an exhaustive textbook; it has been brought well up to date and should prove a valuable handbook for those who combine clinical and laboratory work. W. F. M. L.

THE DIAGNOSIS AND TREATMENT OF THE INFECTIOUS DISEASES. By F. H. Thomson, M.B., C.M., D.P.H. London: H. K. Lewis and Co. 1924. Pp. viii + 208. Price 10s. 6d.

This is another of the publications, specially designed for the use of practitioners, which have become a feature of medical literature during the last few years. In it, Dr. Thomson gives the clinical experiences of infectious diseases that he has acquired during thirty-four years in the service of the Metropolitan Asylums Board.

The impressions the reader gathers is that Dr. Thomson approaches the infectious diseases from an angle identical with that of the general practitioner, and places the scientific methods of diagnosis in the same position in which these methods stand in relationship to the medical man in actual practice at the present day. He does not seem to advocate a continual appeal to bacteriology, though he realizes the great assistance that this science can give. Thus his teaching is perhaps directed towards that important acquisition—a clinical sense. In diphtheria he states that the value of bacteriological findings has been exaggerated, and he emphasizes that it is the duty of the clinician to depend on himself, as diphtheria must be diagnosed and treated at the earliest possible moment; otherwise, a proportion of cases will be lost.

The book contains sound, practical clinical teaching that will help the practitioner in his difficulties and doubts. M. B. H. R.

THE EXTRA PHARMACOPŒIA OF MARTINDALE AND WESTCOTT. Revised by W. Harrison Martindale, Ph.D., F.C.S., and W. Wynn Westcott, M.B.Lond., D.P.H. Eighteenth Edition. Vol. I. London: H. K. Lewis and Co. 1924. 27s. 6d. net.

This is the first volume of the eighteenth edition of Martindale and Westcott's book. It contains more pages than the previous edition of four years ago, owing to the progress which has taken place in therapeutics during this short period. Though a large number of now useless drugs have been omitted and much condensing has been done, yet the advance of therapeutical knowledge has occasioned an increase in order that the book can retain its high standard of completeness.

The work is a veritable mine of professional information in which one can find condensed and abridged opinions on subjects extending far beyond the limits of therapeutics proper. The section on vaccines and anti-toxins occupies no less than seventy-six pages, in which are included preparation and standardization, dosage, indications for use, etc., backed by extracts from the opinions of leading authorities. This is a feature of the book all the way through; for example, under quinine the reader will find much valuable information regarding the prophylaxis and treatment of malaria in which is noted a reference to the *Journal of the Royal Army Medical Corps*.

Insulin, its modes of preparation, standardization and employment, is described very completely. The authors have succeeded in publishing a book that is up-to-date and accurate, paying more attention to the advances of therapeutics than to the older remedies which are in gradual process of relegation to the therapeutical scrap-heap. It is, perhaps, this spirit of progress which lights up a subject that might otherwise tend towards the prosaic. Like most branches of medical science, therapeutics is advancing rapidly, but the rate of advance is probably not realized by everyone.

It is the perusal of a book such as the Extra Pharmacopœia which demonstrates both the importance and the potentialities that the subject holds.

A sentence at the end of the author's preface merits attention. It refers to an appeal to the practitioner to help forward the British chemical industry. "A man's life is a wondrous balance of four factors—his love for his Creator, his love for kith and kin, his love for the land of his birth, and his love for the work he has been set to do. Upset one of these factors, and you spell disaster." M. B. H. R.

Landmarks and Surface Markings of the Human Body. By L. Bathe Rawling, M.B., B.C., F.R.C.S. With thirty-six illustrations. Sixth Edition. London: H. K. Lewis and Co., Ltd. 1924. Pp. viii × 97. Price 7s. 6d.

This book, published originally in 1912, is the sixth edition, the fifth having been reprinted seven times. Many of the illustrations are new and improved. The text is in close relationship to the illustrations and is concise. An appendix gives much useful information regarding dimensions and weights of organs, together with the ossification and epiphyses of bones.

The work is so familiar to surgeons that it scarcely requires comment. It is an excellent book that will continue in popularity.

M. B. H. R.

The Debt of Science to Medicine, being the Harveian Oration delivered before the Royal College of Physicians of London on St. Luke's Day, 1924. By Archibald E. Garrod, K.C.M.G., D.M., LL.D., F.R.S.

The oration deals with the various branches of natural science which have branched off from the parent stock, medicine. These are dealt with seriatim, and instances of medical men who have been prominent exponents of these different sciences are recorded. The science of astronomy for instance, at one time so closely allied with mediæval medicine, owes much to Twyne, to Copernicus and to Bambridge. Geology likewise has been advanced by Steensen, Woodward and others. And so on through the whole list of sciences, physics, chemistry, botany, zoology, in every instance some medical men are shown to be foremost in throwing light on these different branches of natural science.

Correspondence.

SINGAPORE—THE BRIGHTER SIDE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—With reference to Major Harrison's article I should like to make the following observations :—

(1) *Cost of living.*—After a year's residence in Singapore I have not found anyone who contends that the food is cheaper or better than at home. The standard is certainly not higher than at home, and for health reasons we eat less.

(2) *Servants.*—Major Harrison quotes a sum for the second boy which no good servant would accept. He also omits his wife's amah, chauffeur (syce) and a gardener, which we must keep. A "contract" system is seldom employed.

(3) *Houses.*—The new houses are "grotesquely" small, and only suitable for a married couple without children. I have not found a single civilian who has suffered a pang of envy over the garrison bungalows. Tastes differ, but there must be few officers who would prefer Major Harrison's house to the residence of the G.O.C.

(4) *Hotels.*—A pound a day is not expensive for a really good hotel, but the principal ones are in the city and not suitable for prolonged residence or for children. Further, very few married junior officers with a family can afford to stay in these hotels, even with reduced charges for a prolonged stay.

(5) *General.*—Under this heading Major Harrison refers to the hospitality extended by civilians who recognize "the natural disadvantage at which an officer finds himself." This is the point we have been trying to make, and few soldiers like to receive hospitality without being able to return it.

In conclusion, it may be stated once more that Singapore is a most attractive station, its chief drawback is the expense of life in general, which hits the junior badly, and the housing question which hits everyone.

I am, etc.,

E. HOPE FALKNER.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

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Original Communications.

"OVERCAME SOLDIERS ACCUSTOMED ONLY TO THE USAGES OF THE PAST."[1]

I.

A PLEA FOR THE FORMATION OF A FOURTH BRANCH OF THE STAFF . . . HEALTH STAFF . . . "H" BRANCH, AND FOR THE EXTENSION AND ALTERATION OF EXISTING CONCEPTIONS OF THE RATIONALE AND FUNCTIONS OF THE MEDICAL SERVICE.

By MAJOR H. S. BLACKMORE, O.B.E.
Royal Army Medical Corps.

WITH the advance of knowledge and understanding, the relative position and importance of the Medical Service has changed. This change has been accelerated by the late war, but the true position of the Medical Service of a modern army, its real functions, and the scope and extent of its possibilities as an aid to the achievement of victory do not seem to be fully realized.

In the past the medical services of an army were looked upon as being a necessary evil, but none the less an evil, and as a natural result they and their activities were relegated to a very subordinate and barely tolerated position in the scheme of things military. But warfare has changed, and in two ways. First, the conception of "humanity" has crept in, and now occupies a very strong position in the eyes of the general public, and therefore is necessarily accorded more recognition by those responsible for the conduct of army affairs; secondly, war is less an affair of relatively small bodies of professional soldiers than a struggle between whole nations, mobilized if not actually in arms, and this has brought into great, and possibly decisive import, all the factors included in the term "man power."

[1] A quotation from W. Morris's "Napoleon," p. 205.

As a corollary to this, and especially pertinent to the question of man power, there is the gradual awakening to the fact that "prevention is better than cure," and the growth of that side of medical science. Evidence of this is to be found in the establishment of a ministry of health, and in the army directorates of hygiene and pathology. But the advance has been meagre in the army, and on the wrong lines. If the army, and therefore the nation, is to get the benefit of all the great potentialities which are inherent in its medical service, then a fresh start must be made. The last remnants of the old idea that the medical service and its functions are of secondary importance must be thrown overboard, and the matter approached with an open mind shorn of all preconceived notions.

The plea which is being put forward is not for the aggrandizement of the medical service but for the benefit of the army as a fighting machine. As Major M. B. H. Ritchie, R.A.M.C., has said in his paper entitled "The War Efficiency Value of a Wider Outlook for the Medical and other Services of the Army."[1]. . . . "It is easier to be serf than chief, and it is difficult to become chief if most of a lifetime has been passed in serfdom," . . . and the increased responsibilities of the medical service would not be a light burden.

Stated briefly and in general terms this plea is that the present conception of the medical service and its functions should be radically changed, so as to be more in keeping with the trend of modern thought, and so as to give full scope to its potentialities as an exponent of modern medical science: the fact should be squarely faced that the disaster of a medical failure may well be, and often has been, far more costly than a tactical or strategical defeat: it should be clearly recognized that the present subordination, deprivation of co-ordination and executive control, diversity of requirements and channels of meeting the same, are quite enough to justify the conclusion that any success achieved by the medical service up to date has been in spite of, and not because of its organization.

I am well aware that destructive is much easier than constructive criticism, and now turn to the latter with considerable trepidation, and a last appeal for an open mind and a complete casting out of preconceived and time-honoured shibboleths.

The first necessity is for a definite grasp of the fact that the Medical Service exists first, last, and all the time for the purpose of supplying healthy men. In other words it is not essentially a medical service at all but a "Health Service," and the first suggestion is the abandoning of the old title, with all its moss of prejudice and misconception, and the adoption of the new prefix of "Health," which serves the double purpose of opening the mind to accept new ideas untrammelled by old associations, and also points the line that the new thought should follow: secondly, the corps must realize, and make others realize, that it is not a collection of doctors in uniform, but soldiers who are specialists in problems of "health": thirdly, there must be recognition of two facts: (1) That the multitudinous

variety of detail which is included in a real understanding of this question of providing, preserving and restoring health is the business of the Health Service, and that to delegate any part of it to any other branch is to convict oneself of either a want of the power of clear thinking, or of employing an inefficient or unnecessary service: (2) That responsibility without co-ordinating and executive control is an obvious absurdity. To exemplify my meaning I would suggest a reference to, and a correlation of the following paras. of F.S.R., vol. i, 1923 (provisional), 35-3 (ii, iii, iv) and 5 (v, vii), 38-2 (ii, iii*c*), 27-8, 43-5, etc., and a reference to "The Official History of the War. Medical Services. General History," vol. iii, page 50, etc.

Suppose, for the sake of argument, that the force and desirability of the foregoing plea be admitted, then comes the question: "How is this consummation to be attained?" The first and immediate necessity that springs to one's mind is . . . the co-operation of the rest of the army, but, so convinced am I of the far-reaching advantages which would accrue that I think the reform could be pushed through without it, and would eventually win it for itself as the direct reward of obvious good results, but it would be a difficult task. Secondly, one must begin at the top because of that factor of autonomous co-ordination which is always of such vital importance, and also for the following special reasons: (*a*) this is an age of specialization, and knowledge plus training and experience = UNDERSTANDING: (*b*) the multiplicity and complexity of the range of requirements, and the variety of the fields of influence necessary for the production of maximal results predicates CO-ORDINATION, which is coupled with UNDERSTANDING: (*c*) the paramount need of anticipation. The old adage that prevention is better than cure is stressed by the fact that once prevention has failed, cure may never be possible, and in any case will be attained after the damage, from the strategical or tactical point of view, has been done. Hence there must be as few wheels within wheels, or "spokes in the wheel," as possible . . . ergo, AUTONOMY, and of course UNDERSTANDING: (*d*) the tendency of human nature is always to miss that which is not patent and obvious. Now, some of the most important work of a health service, which has very far-reaching results, is such that the aim is neither patent nor obvious, and this therefore goes oftenest to the wall. There is no blame to anyone in this, it is natural and inevitable *without* AUTONOMY and UNDERSTANDING.

Therefore, as the natural and inevitable conclusion there must be a fourth branch of the staff . . . . Health Staff . . . . "H" branch. This branch must be autonomous, subordinate only to the Commander-in-Chief and the requirements of "G" branch (as are the "A.G." and "Q.M.G." branches), and must have executive control of *all health matters*.

This is the principle which must pervade the whole of the health service. It would require many alterations of existing regulations and establishments, not the least alteration being in the general conception of rationale and

Functions under main and sub-heads	Suggested revision of existing conditions: Direct responsibility	Suggested revision of existing conditions: Executive control	Suggested revision of existing conditions: Indirect, i.e., advisory, responsibilty	Conditions as they are at present: Direct responsibility	Conditions as they are at present: Executive control	Conditions as they are at present: Indirect, i.e., advisory, responsibility	Co-ordination and general control: Suggested	Co-ordination and general control: At present
I. *Preservation of health and prevention of disease*								
(*a*) Rations—								
(i) Ingredients, quantities and proportions	Health Service	Health Service	..	Supply Service	Supply Service	Medical Service	"H" Staff	Q.M.G.S.
(ii) Quality	Supply Service	Supply Service	Health Service	Supply Service	Supply Service	Medical Service	Q.M.G.S.	Q.M.G.S.
(iii) Supply	Supply Service	Supply Service	..	Supply Service	Supply Service	..	Q.M.G.S.	Q.M.G.S.
(*b*) Water—								
(i) Quality—including the means adopted to attain the required standard	Health Service	Health Service	..	Engineer Service and Medical Service	Medical Service and Engineer Service	Medical Service	"H" Staff	A.G.S.
(ii) Quantity	Engineer Service	Engineer Service	Health Service	Engineer Service	Engineer Service	Medical Service	Q.M.G.S.	Q.M.G.S.
(iii) Supply	*Engineer Service or Transport Service	Engineer Service or Transport Service	..	Engineer Service or Transport Service	Engineer Service or Transport Service	..	Q.M.G.S.	Q.M.G.S.
(*c*) Clothing — including blankets and ground sheets—								
(i) Pattern	Health Service	Health Service	..	Q.M.G.S.	Q.M.G.S.	..	"H" Staff	Q.M.G.S.
(ii) Amount	Health Service	Health Service	..	Q.M.G.S.	Q.M.G.S.	Medical Service	"H" Staff	Q.M.G.S.
(iii) Material	Health Service	Health Service	..	Q.M.G.S.	Q.M.G.S.	Medical Service	"H" Staff	Q.M.G.S.
(iv) Quality	Ordnance Service	Ordnance Service	Health Service	Ordnance Service	Ordnance Service	Medical Service	"H" Staff	Q.M.G.S.
(v) Supply	Ordnance Service	Ordnance Service	..	Ordnance Service	Ordnance Service	...	Q.M.G.S.	Q.M.G.S.
(*d*) Physical and physiological factors—								
(i) Weight carried by the soldier	G.S.	G.S.	"H" Staff	G.S.	G.S.	Medical Service	G.S.	G.S.
(ii) The march—regulations for rate, time, march discipline, etc,	"H" Staff	..	..	G.S.	..	Medical Service	"H" Staff	G.S.
(*e*) Accommodation—								
(i) In tents	"H" Staff	Ordnance Service	..	Q.M.G.S.	Ordnance Service	Medical Service	"H" Staff	Q.M.G.S.
(ii) In billets .. (iii) In quarters	Director of Hirings or Director of Works	Director of Hirings or Director of Works	Health Service	Director of Hirings or D. of W.	D. of H. or D. of W.	Medical Service		

(*f*) Sanitary (i.e. conservancy), appliances and material	Health Service	Health Service	..	Engineer Service Ordnance Service Supply Service Medical Service	Engineer Service Ordnance Service Supply Service Medical Service	Medical Service	"H" Staff	A.G.S. and Q.M.G.S.
(*g*) Health measures (old term "sanitation") in units and formations	Officers Commanding	Officers Commanding with responsibility to "H" Staff	Health Service	O's. C.	O's.C. with responsibility to A.G.S.	Medical Service	"H" Staff	A.G.S.
(*h*) Health measures—vaccination, inoculation, etc.	O's. C.	O's. C. with responsibility to "H" Staff	Health Service	O's. C.	O's.C. with responsibility to A.G.S.	Medical Service	"H" Staff	A.G.S.
(*i*) Cleansing— (i) Disinfection (ii) Disinfestation	Health Service	Health Service	..	Medical Service	Medical Service	..	"H" Staff	A.G.S.
(iii) Laundries	Health Service	Health Service	..	Ordnance Service	Ordnance Service	Medical Service		Q.M.G.S.
(iv) "Cleansing units"—if and where formed	Health Service	Health Service	..	?	?	Medical Service		? Q.M.G.S.
II. *Care of sick and wounded* (*a*) Provision of specialized medical and surgical equipment	..	..	..	..	..	..	"H" Staff	A.G.S.
(*b*) Invaliding	..	..	..	..	..	..	"H" Staff	A.G.S.
(*c*) Personnel of Medical (Health) Service	..	..	..	..	..	..	"H" Staff	A.G.S.
(*d*) Interior economy of Medical (Health) Units	..	..	..	..	..	..	"H" Staff	A.G.S.
(*e*) Tactical disposition of Medical (Health) Units	..	..	..	..	..	..	"H" Staff, after consultation with G.S.	A.G.S. after consultation with G.S.
(*f*) Siting and construction of hospitals, hospital trains and ships and dieting in hospital	..	..	..	..	..	..	"H" Staff	Q.M.G.S.
III. *Chemical warfare* (*defence*) C.W. defence in the absence of special C.W. Service organization (for argument see paper II of this series, and for suggestions, etc., C.W. Service see paper III)	Health Service	Health Service	..	Unsettled	Unsettled	Unsettled	"H" Staff	A.G.S. and Q.M.G.S. indefinite and unsettled

Abbreviations :—
G.S. = General Staff.
A.G.S. = Adjutant Generals' Branch of the Staff.
Q.M.G.S. = Quartermaster Generals' Branch of the Staff.
H.S. = Health Branch of the Staff.
O's. C. = Officers Commanding.
D. of H. = Directors of Hirings.
D. of W. = Director of Works.

• *Note.*—Engineer Service is understood to include "Works." The preposition "or" denotes definite alternative according to circumstances, and does not imply overlapping as does the word "and."

functions, and this latter change would be greatly assisted by the adoption of the logical general title of "Health Service," under which the corps would become the Royal Army Health Corps.

Attached is a table which is intended to give some idea of what the suggested changes would mean. It is not claimed that it is complete, and modifications would doubtless be revealed as necessary by closer study of the questions involved, and by practical application of the principles.

As one specific instance of such changes, one may cite the following: Sanitary (conservancy) material and appliances would be taken over in bulk from their various sources and distributed in detail by the Health Service Units designed for the purpose. I have employed a Divisional Sanitary Section to do this under active service conditions, and in spite of the fact that its organization, not having been designed for the purpose, is far from ideal, the results were very satisfactory. Satisfactory from the Medical point of view, because one obtained centralized and expert control, uniformity of methods and materials, considerable saving of wasteful expenditure, and valuable information as to the standard of sanitation maintained by the various units respectively; satisfactory from the Unit point of view, because their source of supply was definite and unified; satisfactory from the various Corps point of view, because they exchanged large numbers of small indents for small numbers of large ones.

I have not touched upon the matter of what, if any, special extra training would be called for because I have tried to keep the whole treatment of my subject to lines as general as possible, but one can see that it might well bring into being the opening of a certain number of vacancies for "health" officers at staff college courses: surely a very desirable result.

Nor have I trenched sufficiently far upon Major Ritchie's ground to consider the general question of the staff and the services. In fact I have resisted the lure of "red herrings" across my path, to the best of my ability, and tried to keep myself within the bounds of the title of my screed.

REFERENCE.

[1] RITCHIE, M. B. H., JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xliii, No. 4, October, 1924.

A COMMAND STAFF EXERCISE.

By Major W. Egan, D.S.O.
Royal Army Medical Corps.

(*Continued from p.* 182.)

Reference your Medical Appreciation.

The following remarks are forwarded for your information (Marks twenty-five per cent) :—

(1) A poor appreciation. You do not appear to have grasped the fact that a reasoned, lucid summary of the medical factors and problems for the assistance of the Staff, is required.

(2) Your estimated strength of the Force is too low. You should have consulted War Establishments for these.

(3) You have omitted map references and failed to mark your appreciation "SECRET."

(4) Your siting of Medical Units is on the whole good, but your Casualty Clearing Stations should be at Ayton, one open and one on train, parked at siding. Your Advanced Depot of Medical Stores and Motor Ambulance Convoy should also be at Ayton.

(5) You have omitted to consider the following :—

(*a*) Topography, as it affects the Medical Services.
(*b*) Prevalent diseases.
(*c*) Infectious and venereal diseases, also scabies and lice.
(*d*) Supplies.
(*e*) Water.
(*f*) Clothing of troops.

(6) You have not worked out your bed accommodation.

(7) What arrangements do you propose for the General Hospitals in the capital of your country which is your home base?

(8) You have made no arrangements for accommodation for Sick Nursing Sisters, Prisoners of War, etc.

(*Signed*) Directing Staff (Medical).

Medical Situation at 16.00 Hours, June 9. By D.D.M.S., 1st Southland Corps.

(1) Medical Base at Newcastle-on-Tyne, where the following units are located :—

Nos. 1, 2 and 3 General Hospitals of 1,200 beds each. (No. 1 has accommodation for thirty Nursing Sisters.)

Nos. 4 and 5 General Hospitals of 600 beds each. These two units are parked ready for despatch by sea or rail to Edinburgh.

No. 6 General Hospital (600 beds) for Prisoners of War.
No. 1 Convalescent Depot (2,000) beds.
No. 1 Base Depot Medical Stores.
Base Hygiene Laboratory.
No. 1 Dental Centre (established at Convalescent Depot).
No. 1 Auxiliary Motor Ambulance Company (less one section).
Nos. 1 and 2 Hospital Ships (350 beds each).
No. 1 Sanitary Section.

(2) At Advanced Base, Berwick-on-Tweed, the following units are located :—

No. 7 General Hospital (1,200 beds) with special wards for :—
(i) Wounds of head.
(ii) Wounds of chest.
(iii) Wounds of abdomen.
(iv) Eye cases.
(v) Fracture femur cases.
No. 8 General Hospital (600 beds) for infectious cases.
No. 9 General Hospital (600 beds) for venereal cases.
No. 2 Convalescent Depot (2,000 beds).
No. 1 Mobile Laboratory (Hygiene).
No. 2 Mobile Laboratory (Bacteriological).
No. 2 Dental Centre.
No. 1 Auxiliary Motor Ambulance Coy. (less H.Q. and one section).
No. 2 Sanitary Section (providing squads for railheads).

(3) At Burnmouth :—
1st M.A.C.
No. 7 Field Ambulance.
No. 3 Sanitary Section.
No. 1 Advanced Depot Medical Stores.
No. 1 Casualty Clearing Station.
No. 2 Casualty Clearing Station.

(4) Other Field Medical Units are in the areas of their respective formations.

(*Signed*) Colonel "A.,"
D.D.M.S., 1st Corps

Remarks on Medical Situation, June 9, by D.D.M.S. 1st Corps.

(1) Base depot medical stores should be at Berwick.

Your hospital ships need not be considered.

Your sanitary sections should remain with divisions and corps and if extra sanitary sections are necessary you should number them in sequence.

Your ambulance trains should garage at Burnmouth.

Your casualty clearing stations should be at Ayton, No. 1 open, No. 2 loaded on trucks. Your M.A.C. and corps sanitary section (No. 3) should be at Ayton. (*Signed*) Directing Staff (Medical).

1st CORPS, R.A.M.C. ORDERS No. 1.

SECRET.
No. 1.
Copy No.......
June 9, 1924.

Reference Map, O.S. of Scotland, Sheets 33 *and* 34, *one inch to one mile.*

(1) All casualties for whom evacuation is deemed necessary will be cleared from field ambulances by 21.00 hours to-night.

(2) Casualties from 1st Division and 1st Lancers will be col ected at No. 3 Field Ambulance, under arrangements made by A.D.M.S. 1st Division. Casualties from 2nd Division will be collected at No. 6 Field Ambulance, under arrangements made by A.D.M.S. 2nd Division. Casualties from Cavalry Brigade will be transferred (for subsequent evacuation), to No. 6 Field Ambulance, under arrangements made by S.M.O., Cavalry Brigade. Casualties from Corps Troops will be collected under arrangements made by O.C. 7th Field Ambulance and evacuated to No. 2 Casualty Clearing Station, at Burnmouth.

(3) A.D.'sM.S. Divisions will notify O.C. First M.A.C. the number of ambulance cars required, time and place at which the M.A.C. cars are to report.

(4) Any infectious cases admitted to field ambulances to-day, will be evacuated direct in Divisional Ambulance cars to No. 8 General Hospital at Berwick.

(5) A.D.'sM.S. Divisions and O.C. 7th Field Ambulance will notify to D.D.M.S., 1st Corps, the names and units of all officers evacuated, and the total number (and units) of all ranks evacuated.

(6) Nos. 1 and 2 Casualty Clearing Stations are each in possession of a reserve of 500 stretchers and 1,000 blankets. This reserve is to be maintained by replacements obtained from ambulance trains.

(7) Reports to Headquarters at Ayton.

(8) Acknowledge.

Despatched by S.D.R. at 14.00 hours. (*Signed*) COLONEL "A.,"
D.D.M.S., 1st Corps.

Copies to:—No. 1. S.M.O., Cavalry Brigade.
No. 2. A.D.M.S., 1st Division.
No. 3. A.D.M.S., 2nd Division.
No. 4. O.C., 7th Field Ambulance.
No. 5. O.C., 1st M.A.C.
No. 6. O.C., 1st C.C.S.
No. 7. O.C., 2nd C.C.S.
No. 8. 1st Corps (G) for information.
No. 9. 1st Corps (A and Q) for information.
No. 10. 1st Cavalry Brigade for information.
No. 11. 1st Division for information.
No. 12. 2nd Division for information.
No. 13. War Diary.
No. 14. File.

REMARKS ON 1ST CORPS, R.A.M.C. ORDER NO. 1.

Para. 2. It is considered that you should not nominate the particular field ambulance for the clearing of casualties, but leave that to the A.D.M.S. of the formation concerned. The only exception to this is for Corps Troops—for which you have one ambulance directly under your administration.

Para. 3. The M.A.C. is a Corps unit, any demands for cars from formations should be made direct to you to enable you to handle adequately your motor ambulance cars and distribute as necessity demands.

Para. 4. Have you considered wear and tear of division ambulance cars in the long journey from divisional units to Berwick and return?

Para. 6. Your reserve of 500 stretchers and 1,000 blankets per C.C.S. errs on the small side and it is at Burnmouth, which is too far behind.

(*Signed*) DIRECTING STAFF (Medical).

2ND DIVISION R.A.M.C. ORDER NO. 1.

SECRET.
Copy No.

June 9, 1924.

Reference Map, O.S. of Scotland, Sheets 33 *and* 34, *one inch to one mile.*

(1) Additional stocks of anti-tetanic serum should be at once requisitioned by M.O.'s i/c effective troops and O.C.'s field ambulances, and this serum should be freely used with wound casualties during the advance on Edinburgh.

(2) M.O.'s will undertake weekly inspections for lice and scabies, arrange for periodic disinfestation of clothing, blankets and towels, and have scabies cases isolated for treatment under unit arrangements.

(3) Informal talks with the troops on precautionary measures against venereal disease, lice and scabies should be taken advantage of by M.O.'s and provision made for E.T., venereal disease.

(4) Special attention should be paid to the destruction of all rats in billeting areas owing to the risk of spread of infection of infective jaundice.

(5) S.M.O.'s Infantry Brigade Troops will notify M.O.'s i/c troops *re* orders 1, 2, 3 and 4.

(6) All casualties for whom evacuation is necessary will be cleared from field ambulances by the following methods:—

(*a*) Casualties from 4th and 5th Field Ambulances in the Units' motor ambulances by road Whinhouse—Bellstruther Bog to Moorhouse, handing over to O.C. No. 6 Field Ambulance by 20.00 hours.

(*b*) O.C., 6th Ambulance will evacuate all casualties from 4th, 5th and 6th Field Ambulances and all casualties transferred by S.M.O., Cavalry Brigade in the twenty-five motor ambulances detailed for that purpose by O.C., 1st M.A.C., by road Moorhouse—Preston—Chirnside to No. 2 Casualy Clearing Station at Burnmouth. No. 6 Field Ambulance will be cleared by 21.00 hours to-night.

(7) Any infectious cases admitted to field ambulances to-day will be evacuated direct in divisional ambulance cars to No. 8 General Hospital at Berwick.

(8) O.C.'s field ambulances will notify this office daily by 14·00 hours the names and units of all officers evacuated, and deaths, and the total numbers (and units) of other ranks evacuated.

(9) Reports to Divisional Headquarters at Fulfordlees.

(10) Information as per page 2—Medical units sited as under, etc.

(11) Acknowledge.

Issued at 16.00 hours by Motor Cyclist.

LIEUTENANT-COLONEL, R.A.M.C., T.
A.D.M.S., 2nd Division.

Copies to :—No. 1. O.C., 4th Field Ambulance.
No. 2. O.C., 5th Field Ambulance.
No. 3. O.C., 6th Field Ambulance.
No. 4. O.C., 2nd Sanitary Section.
No. 5. D.D.M.S., for information.
No. 6. G.O.C., 2nd Division.
No. 7. Headquarters, 2nd Division (A and Q).
No. 8. File Copy.
No. 9. War Diary.

INFORMATION.

Medical Units cited as under will function after 16.00 hours, June 9, 1924.

Medical Base at Newcastle-on-Tyne.

Nos. 1, 2, and 3 General Hospitals of 1,200 beds each. (No. 1 has accommodation for thirty Nursing Sisters.)

No. 6 General Hospital (800 beds) for Prisoners of War.

No. 1 Convalescent Depot (2,000 beds).

No. 1 Base Depot Medical Stores.

Base Hygiene Laboratory.

Base Pathological Laboratory.

No. 1 Dental Centre (established at Convalescent Depot).

No. 1 Auxiliary Motor Ambulance Company (less 1 section).

At Advance Base, Berwick-on-Tweed.

No. 7 General Hospital (1,200 beds) with special wards for—

(1) Wounds of head.
(2) Wounds of chest.
(3) Wounds of abdomen.
(4) Eye cases.
(5) Fracture femur cases.

No. 8 General Hospital (600 beds) for infectious cases.

No. 9 General Hospital (600 beds) for venereal cases.

No. 1 Mobile Laboratory (Bacteriological).
No. 2 Dental Centre.
No. 1 Auxiliary Motor Ambulance Company (one section).
Nos. 1 and 2 Ambulance Trains.

At Burnmouth.

1st M.A.C.
No. 7 Field Ambulance for Corps Troops.
No. 1 Advanced Depot Medical Stores.
No. 2 Casualty Clearing Station (open).
No remarks by Directing Staff (Medical).

During the exercise three situations were developed and in each case the Corps orders and administrative instructions, together with the Divisional orders, are given.

Royal Army Medical Corps orders issued by the D.D.M.S. and A.D.M.S. are given in full with the remarks by the Medical Directing Staff in each case.

FIRST SITUATION.

Situation 1.—In view of the information given above, the 1st Corps Commander decided to continue the advance on Haddington.

Required:

(1) From 1st Corps Commander, a brief appreciation, and from 1st Corps Syndicates, orders and instructions (administrative or otherwise) for the advance.

(2) From 2nd Division, 1st Cavalry Brigade, and 4th and 5th Infantry Brigades Syndicates, orders and instructions (administrative or otherwise) consequent on the above.

Note.—(1) The road Innerwick (E. 11, Sheet 33)—Birkymuir—The Brunt—Spott (D. 9) is unfit for M.T.

(2) Notes of any conferences held, or action taken, which is not apparent from the orders, etc., issued by syndicates, will be forwarded at the same time to the directing staff at command headquarters.

SECRET.
Copy No.—

1ST CORPS ORDER No. 7.

June 9, 1924.

Reference Map, O.S. of Scotland. Sheets 33 and 34, *one inch to one mile.*

(1) Small bodies of Northland troops occupy high ground, north and south of Haddington. Reinforcements are being hurried to this area from north.

(2) Advance on Edinburgh will be continued to-morrow with view of defeating enemy forces east of Edinburgh at earliest opportunity.

(3) (*a*) 1st Lancers (less two troops) and 1st Armoured Car Company attached (Lieutenant-Colonel X., 1st Lancers) will move to secure crossings at Tynebridge and East Linton by 05.00 hours and will reconnoitre high ground north of Haddington.

One troop 1st Lancers will be detailed to each 1st and 2nd Divisions for duty with advanced guards. They will come under orders of these Divisions on receipt of this order, and return to their Unit on completion of duty.

(*b*) 1st Cavalry Brigade will move to reach line Garvald—Gifford by 05.00 hours with object of securing high-ground Traprainlaw—Whitelaw Hill—Winding Law. When these points are secured brigade will push forward with troops not required to hold them with object of gaining ground further west and locating enemy's right flank.

(*c*) 1st Division (less mechanical transport) will march at 05.00 hours on East Linton. *Starting point* 35th milestone. Cockburnspath—East Linton Road. *Route.* Bilsdean—Broxburn—East Linton Road and any roads north of this are available. *Billeting Area.* East Linton—West Barnsparkend.

(*d*) 2nd Division (less mechanical transport) will march at 05.00 hours on Whittinghame. *Starting point.* Oldhamstocks. *Route.* Innerwick—Spott and all roads south, but exclusive of Bilsdean—Broxburn—East Linton Road, are available. *Billeting Area.* Whittinghame—Stenton—Spott.

(*e*) Corps Artillery, Engineers (less 1st Field Survey Company) and Tanks will march in accordance with attached time table. 1st Balloon and Signal Sections will march with Corps Artillery.

(*f*) 1st A. A. Artillery Brigade will march in accordance with attached march table. O.C. Brigade will organize air defence of new Corps area, arranging protection for railheads and refilling points. The following points in present Corps area will not be uncovered :—

Reston—Grantshouse.

(*g*) Mechanical Transport of 1st and 2nd Divisions, Engineers and Corps Signal Company will move in accordance with attached march table.

(*h*) One Brigade 1st Division will be detailed as Corps Reserve.

(4) Press Castle—Old Cambus Tower Road will be closed for all transport Corps Artillery and Tanks from 10.30 hours to 13.00 hours.

(5) Corps Headquarters closes Ayton 12.00 hours: Opens Broxburn 12.00 hours.

(6) Acknowledge.

Issued to Signals 12.00 hours.

* * * * *

Colonel, G.S., 1st Corps.

Copy No. 1.	1st Division.	Copy No. 9.	1st Armoured Car Coy.
2.	2nd Division.	10.	G.O.C.
3.	1st Cavalry Brigade.	11.	G.
4.	1st Lancers.	12 & 13.	A. & Q.
5.	1st Corps Artillery Com.	14 & 15.	Intelligence.
6.	1st A.A. Arty. Brigade.	16.	C.E.
7.	C.R.E., Corps R.E.	17.	C.S.O.
8.	1st Tank Brigade.	18.	D.A.D. Survey.

Copy No. 19. A.D. of T.
20. A.D. of S. and T.
21. D.D.M.S.
22. A.D.V.S.
23. D.A.D. Postal.
Copy No. 24. A.P.M.
25. Camp Commandant.
26 & 27. War Diary.
28 & 29. File.
30. H.Q. 1st Wing, R.A.F.
Copy No. 31. Corps Signal Company.

SECRET.
Copy No.—

ADMINISTRATIVE INSTRUCTIONS TO ACCOMPANY SOUTHLAND'S CORPS ORDERS No. 7.

June 9, 1924.

Reference O.S. Sheets (½ inch) 33 and 34.

MEDICAL.

1st M.A.C. now at Burnmouth will move to Grantshouse at 08.00 hours on June 10, followed by 7th Field Ambulance and 3rd Sanitary Section. The D.T. will arrange for the rail move of No. 1 Casualty Clearing Station and No. 1 Advanced Depot Medical Stores from Burnmouth to Grantshouse.

No. 2 Casualty Clearing Station will remain at Burnmouth.

* * * * * *

D.A.A. & Q.M.G., 1st Corps.

Copies to all recipients of Southland's Corps Order No. 7.

SECRET.
Copy No.—

1ST CORPS, R.A.M.C., ORDERS No. 2.

Reference Map O.S. of Scotland. Sheets 33 and 34, one inch to one mile.

June 9, 1924.

(1) Small bodies of Northland troops occupy high ground, north and south-east of Haddington. Reinforcements are being hurried to this area from the north.

(2) Advance on Edinburgh will be continued to-morrow, with a view to defeating forces east of Edinburgh at earliest opportunity.

(3) (*a*) 1st Lancers (less two troops) and 1st Armoured Car Company will move to secure crossings at Tynebridge and East Linton by 05.00 hours.

One troop, 1st Lancers, will be detailed to each of the 1st and 2nd Divisions, for duty with advanced guards.

(*b*) 1st Cavalry Brigade will move to reach line Garvald—Gifford by 05.00 hours, with object of securing high ground Traprainlaw—Whitelaw Hill—Winding Law. When these points are secured, Brigade will push forward with troops not required to hold them, with object of gaining ground further west and locating enemy's right flank.

(*c*) 1st Division (less mechanical transport) will march at 05.00 hours, on East Linton.

(*d*) 2nd Division (less mechanical transport) will march at 05.00 hours on Whittinghame.

(*e*) One Brigade, 1st Division, will be detailed as Corps Reserve.

(4) 1st and 2nd Division Field Ambulances and Sanitary Sections and No. 1 Cavalry Field Ambulance, will march under orders issued by their respective Divisions and Cavalry Brigade Headquarters.

(5) A.D.'sM.S. and S.M.O. Cavalry will report immediately to D.D.M.S. the location of dressing stations which are opened, and will keep him informed as to the numbers and transport classifications of cases awaiting evacuation. The closing of dressing stations will be reported also.

(6) 1s M.A.C. will move to Grantshouse at 08.00 hours on June 10, followed by 7th Field Ambulance and 3rd Sanitary Section. No. 1 Casualty Clearing Station and No. 1 Adv. Depot Medical Stores will move by rail from Burnmouth to Grantshouse, under arrangements being made by the Director of Transport.

(7) No. 2 Casualty Clearing Station remains (opened) at Burnmouth. O.C. No. 2 Casualty Clearing Station will keep D.D.M.S. informed as to numbers and transport classifications of patients awaiting evacuation.

(8) *Railheads :* From 14.00 hours on June 10, will be as follows:—

Supply Railhead. Innerwick Railway Station.

Cavalry Brigade Supply Railhead. Chirnside Station.

Medical Railhead. Grantshouse.

(9) The Garvald—Kingside School Road and the Dunskine—Kingside School Road, will be available for the evacuation of casualties from the 1st Cavalry Brigade.

(10) Corps Headquarters, closes at Ayton, 12.00 hours; opens at Broxburn, 12.00 hours.

(11) Acknowledge.

* * *

Issued to Signals. Colonel,
19.00 hours. D.D.M.S., 1st Corps.

Copies to :– No. 1. S.M.O., 1st Cavalry Brigade.
2. A.D.M.S., 1st Division.
3. A.D.M.S., 2nd Division.
4. O.C., 7th F.A.
5. O.C., 1st M.A.C.
6. O.C., 1st C.C.S.
7. O.C., 2nd C.C.S.
8. 1st Corps (G) for information.
9. 1st Corps (A and Q) for information.
10. 1st Cavalry Brigade for information.
11. 1st Division for information.
12. 2nd Division for information.
Nos. 13 and 14. File and War Diary.

REMARKS ON 1ST CORPS, ROYAL ARMY MEDICAL CORPS ORDER NO. 7.

(1) You do not specify the actual days these movements will take place.

(2) A section of your M.A.C. should be placed under the orders of the S.M.O. Cavalry Brigade, as this formation is likely to be the first engaged and the road evacuation is long with heavy gradients.

(3) M.A.C. Headquarters and two sections should move with Corps Headquarters, as should No. 7 Field Ambulance and No. 3 Sanitary Section.

(4) No. 2 C.C.S., or at any rate the light section of it, should be pushed forward to Innerwick with No. 1 Advanced Depot of Medical Stores. When this casualty clearing station is open, No. 1 should close at Ayton and move to Grantshouse. Medical Railhead should, if possible, be at Innerwick.

(*Signed*) DIRECTING STAFF (Medical).

GENERAL REMARKS ON CORPS MEDICAL ARRANGEMENTS.

Have you represented the following facts to the General Officer Commanding-in-Chief, Force?

(1) The only casualty clearing station which is open and functioning is at Burnmouth, twenty-five miles by road to Spott—Your stretcher and blanket reserves are at Burnmouth—Your ambulance trains at Berwick-on-Tweed. A casualty clearing station, even the light section, cannot open in less than twenty-four hours.

(2) On June 10, your Medical Railhead at 14.00 hours is at Grantshouse. No. 1 Casualty Clearing Station and No. 1 Advanced Depot Medical Stores are moving there preparatory to opening. At 08.00 hours on the same date your motor ambulance convoy commences to move eleven miles from Burnmouth to Grantshouse, followed by your Corps Field Ambulance and Sanitary Section. It would take about one hour for your motor ambulance convoy to reach Grantshouse.

(3) Grantshouse is approximately fourteen miles from Spott.

(4) In the event of casualties occurring between 05.00 and 11.00 hours on June 10, 1924, in the Cavalry Brigade and in the Corps Cavalry Regiments and two Infantry Divisions, how do you propose to deal with them?

(5) Presuming that you have 450 casualties in the Main Force, of whom 90 are dead and 40 require no hospital treatment, you are left with 320, of whom 120 are stretcher cases. This will require a total of 44 of your motor ambulance convoy cars—that is, 30 cars, 120 lying and 60 sitting; 14 cars take remainder of sitting cases. These cars, which have already travelled 11 miles from Grantshouse must travel 14 miles to Spott and 25 miles from there to Burnmouth, and 11 miles return journey to Grantshouse—a total journey of 61 miles; running time, eight hours, at a minimum.

(6) Presuming your Cavalry Brigade had 150 casualties, of whom 30

are dead and 12 of the remainder do not require hospital treatment, you are left with 44 stretcher and 64 sitters. To evacuate these presumably to Burnmouth, you have only the 4 heavy and 6 light motor ambulance cars with the 3 motor lorries of the cavalry field ambulance. How do you propose to clear these wounded, a distance of 52 miles, to casualty clearing station and return to Kingside School? This seems a somewhat arduous task.

(*Signed*) DIRECTING STAFF (Medical).

The D.D.M.S. received the following information by cyclist from Corps "Q":—

D.D.M.S.

Copies to:—1st and 2nd Division, Cavalry Brigade.

No. 1. June 10.

Casualties to-day as follows:—

1st Division: Wounded—twenty-four lying, ninety-six sitting—at main dressing station, Broxburn.

2nd Division: Wounded—forty-eight lying, 192 sitting—at main dressing station, Spott.

Cavalry: Wounded—twenty-four lying, ninety-six sitting—at main dressing station, Kingside School.

Motor ambulance convoy will proceed at once to the above places under your orders. Cars for 1st and 2nd Divisions passing the column marching on the main Berwick—Cockburnspath—East Linton Road.

The 2nd Division will see that the road from Point 74 immediately west of the twenty-eighth milestone to Spott is kept clear for the movement of ambulance cars between 14.00 and 14.30 hours.

(Time of origin, 11.10 hours.)

On receipt of the above the D.D.M.S. issued the following telegrams:—

"Commanding 1st M.A.C.

"From Medical 1st Corps.

"M. 1. June 10.

"Dispatch eighteen ambulances to clear 1st Division Main Dressing Station at Broxburn, and thirty-six to clear 2nd Division Dressing Station at Spott AAA Cars can pass column marching on main Berwick—Cockburnspath—East Linton Road AAA Road from Point 74 west of twenty-eighth milestone to Spott being kept clear for ambulances between 14.00 and 14.30 hours AAA Dispatch eighteen cars to clear cavalry casualties from dressing station at Kingside School; cars may proceed Grantshouse—Hoardwell—Milburn Bridge Road AAA Casualties to be evacuated to No. 1 Casualty Clearing Station at Grantshouse.

"Time of origin, 11.20 hours."

"Commanding 1st Casualty Clearing Station.
"From Medical 1st Corps.
"M. 2. June 10.

"Prepare receive casualties approximately five hundred by 15.00 hours to-day AAA Ambulance train being ordered up to-day to Grantshouse Station.

"Time of origin, 11.30 hours."

"Transport 1st Corps.
"From Medical 1st Corps.
"M. 3, June 10.

"Ambulance train required at Grantshouse Station to-day to clear 1st Casualty Clearing Station there and clear No. 2 Casualty Clearing Station at Burnmouth on return journey.

"Time of origin, 11.35 hours."

"2nd Casualty Clearing Station.
"From Medical 1st Corps.
"M. 4, June 10.

"Ambulance trains will evacuate your patients to-day AAA Prepare to close for move forward Light Section in lorries, remainder by train.

"Time of origin, 11.45 hours."

REMARKS BY THE DIRECTING STAFF ON THE FOREGOING TELEGRAMS.

(1) The M.A.C. cars required are worked out inaccurately. You have forgotten that two sitters can be acccommodated with four stretcher cases per car and that ten sitters can be accommodated in a large ambulance car.

(2) No. 1 Casualty Clearing Station moved on June 10, *re* your R.A.M.C. Order No. 2, to Grantshouse and could not conceivably be ready for the reception of casualties for at least forty-eight hours.

2ND DIVISION ORDER No. 7.

SECRET
Copy No.

June 9, 1924.

Reference Map O.S. of Scotland. Sheets 33 *and* 34, *one inch to one mile.*

(1) (*a*) Small bodies of Northland troops occupy high ground north and south-east of Haddington.

Information points to reinforcements being hurried to this area from the north.

(*b*) 1st Lancers now on the line Broxburn—Spothill, seize the crossings Tynebridge—East Linton, by 05.00 to-morrow.

1st Cavalry Brigade (advanced detachments now at Kingside School)

ordered to occupy the line Garvald—Gifford by 05.00 with further objective Traprainlaw—Whitelaw Hill—Winding Law.

1st Corps continues to advance to-morrow on Haddington.

1st Division on East Linton, starting point Cockburnspath, 05.00.

(2) The 2nd Division will march on Whittinghame in accordance with the march table attached.

(3) *Advanced Guard.*—Commander, Colonel-Commandant A. J. R.

Troops.

"I" Troop, 1st Lancers, present position, Spott House, will rejoin its unit on conclusion of march.

4th F.A. Brigade.

One Pack Battery, 2nd F.A. Brigade.

4th Field Company R.E. (less two sections).

4th Infantry Brigade.

4th Field Ambulance (less one company).

Route.

Innerwick—Birkymuir—The Brunt—Spott—Little Spott—Stenton —Whittinghame, will—

(*a*) Cross the high ground Spott House—Spott Dod—The Chesters Fort at 05.30.

(*b*) Picket the route from spur five hundred yards south of Woodhall to Chesters Fort.

(*c*) Detail one section Machine Guns for Anti-Aircraft Defence astride the valley immediately south of the Brunt.

(*d*) Picket Deuchrie Dod and Spur half mile west of Point 110 during the advance from Spott on Whittinghame.

Troops provided for (*b*) and (*c*) will establish a report centre at the Brunt and will rejoin their units under instruction from Divisional Headquarters.

Main Body.

Main body will march in two columns, march table attached.

(4) *Administrative Arrangements.*—(*a*) Medical. A Main Dressing Station will be established at Spott.

(*b*) Other units not dealt with in these orders and all M.T. will receive orders from "Q" branch.

(5) *Inter-communications.*—(*a*) Reports until 06.00 on 10th, to Fulfordless.

(*b*) Advanced Divisional Headquarters will march at the head of the main body of the Divisional Advanced Guard and will establish a report centre at West Marns, half mile west of Brunt Hill at 06.00, at which hour the report centre at Fulfordless will close. The line of advance of Divisional Headquarters from West Marns will be Pitcox Stenton.

(*c*) Signals will maintain communications with 1st Division.

(*d*) A wireless station will be opened at Advanced Divisional Headquarters at 06.00 at which hour the wireless station at Fulfordless will be closed.

(6) Acknowledge.

* * * *

Major,
General Staff, 2nd Division.

Issued at 21.00.
By Motor Cyclist to:—

	Copy No.
C.R.A.	1
C.R.E.	2
4th Infantry Brigade	3
5th Infantry Brigade	4
6th Infantry Brigade	5
Signals	6
A.D.M.S.	7
Train	8
D.A.P.M.	9
D.A.D.V.S.	10
G.O.C.	11
"Q"	12
Office	13 and 14
War Diary	15
1st Corps	16
1st Division	17
1st Cavalry Brigade	18
2nd Squadron (Army Co-operation)	19
Spare	20-25

Extracts from Administrative Instructions Issued with Division Order, No. 7.

Medical Arrangements.

(*a*) See para 4 Division Order No. 7.

(*b*) Method of evacuation from M.D.S. and location of C.C.S. will be notified later.

Mechanical Transport.

(*a*) (i) Baggage and blanket lorries now with units will remain in their present areas until 11.00 hours on 10th inst., when they will concentrate at unit headquarters at Hoardwell.

(ii) Mechanical transport at divisional signals, field ambulance, sanitary section, divisional ordnance, will concentrate in the

SECRET

Copy No. ....

MARCH TABLE ISSUED WITH 2ND DIVISION ORDER No. 7

No. 1 Column. Commander: Colonel P. A. V. S., Commanding 5th Infantry Brigade.

Serial No.	(a) Date	(b) Formation or Unit	(c) From	(d) To	(e) Starting point	(f) Time	(g) Route	(h) Remarks
1	June 9	No. 1 Bn., 5th Inf. Bde.			Road Junction Point 474, ¾ mile N. of Old Hamstocks	05.30	Innerwick Castle Road Junction Point 159	
2		Div. H.Q. H.Q. Div., Arty. H.Q. Div., R.E.				05.09	Meikle Pinkerton, Little Pinkerton, Doon, Wester Broomhouse	
3		No. 1 Section A, Echelon D.A.C.				05.12	Harkletillaine, Pitcox, Smithy, Stenton	
4		Two Sections 4th Fd. Co., R.E.				05.17		
5		5th Inf. Bde. (less one Battn.)				05.18		
6		5th F.A. Bde.				05.46		
7		2nd P.A. Bde. (less one Battery)				06.15		
8		No. 2 Coy., 4th Fd. Amb.				06.26		
9		Nos. 2 and 4 Sect A, Echelon D.A.C.				06.27		

Column clear of S.P. by 06·35

No. 2 Column. Commander: Colonel-Commandant Commanding 6th Infantry Brigade.

Serial No.	(a) Date	(b) Formation or Unit	(c) From	(d) To	(e) Starting point	(f) Time	(g) Route	(h) Remarks
10	June 9	6th Infy. Bde.			Road Junction Point 474, ¾ mile N. of Old Hamstocks	07.05	Innerwick, Birkymuir, The Brun, Spott	Will detail one Company as rearguard
11		6th F.A. Bde.				07.42		
12		5th Fd. Coy., R.E.				08·10		
13		6th Fd. Coy., R.E.				08.14		
14		5th Fd. Amb.				08.18		
15		6th Fd. Amb.				08.22		
16		No. 3 Section A, Echelon D.A.C.				08.26		
17		R.E. Park				08 31		
18		H.T. Coy., Div. Train				08.32		
19		No. 1 Auxiliary Horse Transport				08.39		
20		Rearguard				09.03		

above order on the White House—Cockburnspath Road under Captain * * , 2nd Divisional Train at 13.30 hours on June 10, head of column 50 yards south of the road junction Tower — Cockburnspath and White House — Cockburnspath Roads.

(iii) "B" Echelon, D.A.C., followed at 100 yards interval by divisional train, M.T., will proceed to 28 milestone on Broxburn—East Linton; route Grantshouse—Cockburnspath — Skateraw — Broxburn. Head of column to pass 36 milestone on Cockburnspath—Tower Road at 14.10 hours.

(iv) The column under Captain * * will follow the divisional train, M.T. at 100 yards interval.

(v) A "Q" Staff Officer will meet the above transport at the 28 milestone on the Broxburn—East Linton Road and issue further instructions.

(vi) The road Innerwick — Birkymuir — Spott is closed to mechanical transport.

* * * *

Major,
for G.O.C., 2nd Division.

Remarks by the Directing Staff on the Divisional Arrangements.

A.D.M.S. 2nd Division.

Have you represented the following to your G.O.C. Reference Divisional Order No. 7?

Para 3.—The 4th Field Ambulance less one company consists of headquarters strength 90, and one company strength 66.

It is considered that the number of stretcher bearers available in one company, i.e., two N.C.O.s and thirty-six men is insufficient.

A complete ambulance should accompany the Brigade.

"B." The other two field ambulances less motor transport should move with their Brigades so as to collect the casualties on the line of march.

"C." Mechanical transport of 4th, 5th and 6th Field Ambulances should march in front of the divisional train and divisional ammunition column, and be under the command of an officer of the Royal Army Medical Corps. This is considered essential for the rapid collection and treatment of the sick and wounded. It is impossible to disentangle rapidly motor ambulance cars and the 3-ton lorries which carry most of the medical equipment, if they are blocked by divisional ammunition column and divisional train. The force is presumably in touch with the enemy and provision for casualties has to be made.

2ND DIVISION, R.A.M.C., ORDER No. 2. **SECRET.**

OPERATION ORDERS.

June 9, 1924.

Reference Map O.S. of Scotland. Sheets 33 *and* 34, *one inch to one mile.*

(1) (*a*) Small bodies of Northland troops occupy high ground north and south-east of Haddington, and reinforcements are being hurried to this area from the north.

(*b*) Our troops seize the crossings at Tynebridge and East Linton by 05.00 hours to-morrow. The 1st Cavalry Brigade will occupy line Garvald—Gifford by 05.00 hours with further objectives Traprainlaw—Whitelaw Hill—Winding Law and ground further west.

(2) 1st Corps will continue advance to-morrow to Haddington.

(3) The 2nd Division (less mechanical transport) will march on Whittinghame in accordance with march orders tables attached, with 1st Division as right flank and 1st Cavalry Brigade as left flank. O's.C. Field Ambulances will arrange to be at starting points at times applicable.

(4) No. 2 Sanitary Section will march in accordance with orders from "Q" branch, 2nd Division, personnel remaining with Mechanical Transport.

(5) O's.C. Field Ambulances will report immediately to A.D.M.S. the location of dressing stations which are opened, and will keep him informed as to the numbers and transport classifications of cases awaiting evacuation ; they will also report the closing of dressing stations.

(6) O.C. 4th Field Ambulance will open an Advanced Dressing Station at the east end of Spott village by 06.00 hours on 10th. The O.C. Advanced Dressing Station will rejoin his unit at Stenton as soon as it is practicable for O.C. 6th Field Ambulance to open a Main Dressing Station at this point.

(7) *Accommodation.*—(*a*) Billeting and bivouacking areas for the night, June 10-11, will be notified as early as practicable on 10th instant.

(*b*) Infantry Brigade Commanders will be responsible for sub-allotting areas allotted to their Brigades, between their own units and any Divisional Troops located therein.

(*c*) The Divisional Troops area (if allotted separately) will be sub-allotted between units by Lieutenant-Colonel * * commanding 2nd Division Ammunition Column.

(8) *Supplies.*—Rations for consumption on 11th instant will be issued at 19.00 hours on 10th instant at Wester Broom House.

(9) *Railheads.*—(*a*) Railhead for supplies on 11th instant will be at Innerwick Station.

(*b*) Medical.—Grantshouse.

(10) Casualties on 11th will be evacuated if possible by road to No. 2 Casualty Clearing Station at Burnmouth after being collected at Main Dressing Station at Spott.

Detailed instructions will be issued later.

(11) *Veterinary Arrangements.*—The D.A.D.V.S. will arrange to establish a veterinary post at Stenton by 15.00 hours on 10th instant.

(12) *Mechanical Transport.*—(*a*) Baggage and blanket lorries now with units will remain in their present areas until 11.00 hours on 10th instant, when they will concentrate at Unit Headquarters at Hoardwell.

Mechanical Transport of Divisional Signals, Field Ambulances, Sanitary Section, Divisional Ordnance will concentrate in the above order on the White House—Cockburnspath Road under Captain * * , 2nd Divisional Train at 13.00 hours on June 10, head of column fifty yards south of the road junction Tower—Cockburnspath and White House—Cockburnspath roads.

The road Innerwick — Birkymuir—Spott is closed for mechanical transport.

(*b*) As soon as units know the location of their billeting area for the night, they will send guides to report to Captain * * , R.A.S.C., at Pitcox (Smithy). He will inform them where the lorries referred to in sub-para (*a*) above are, in order that they may guide them to their units.

(*c*) Guides will be sent to the Supply Refilling Point at 19.00 hours to guide supply vehicles to units.

(13) Reports to 2nd Division Headquarters Fulfordless until 06.00 hours on 10th, after 06.00 hours at West Marns and later at Pitcox and Stenton corresponding with advance.

(14) Acknowledge.

Issued at 22.00 hours by Motor Cyclist.

* * * *

Lieutenant-Colonel, R.A.M.C. (T.)
A.D.M.S., 2nd Division.

Copies to:—No. 1. O.C., 4th Field Ambulance.
2. O.C., 5th Field Ambulance.
3. O.C., 6th Field Ambulance.
4. O.C., 2nd Sanitary Section.
5. D.D.M.S., for information.
6. G.O.C., 2nd Division.
7. Headquarters, 2nd Division (A and Q).
8. File Copy.
9. War Diary.

(*To be continued.*)

OBSERVATIONS ON THE GROWTH OF MENINGOCOCCI *IN VITRO* IN RELATION TO VIRULENCE.[1]

A REPORT TO THE MEDICAL RESEARCH COUNCIL ON WORK CARRIED OUT AT THE UNIVERSITY OF CAMBRIDGE PATHOLOGICAL LABORATORY AND FIELD LABORATORIES.

BY E. G. D. MURRAY AND R. AYRTON.

(*Continued from page* 195.)

(*c*) *The Concentration of Amino-acids.*

We stated above that whatever the concentration of amino-acids in the digest might be, we only added sufficient to increase the Sörensen figure of the extract by a definite amount which had been determined by experiment. This procedure served a useful purpose by indicating two important points: (1) That the yield of growth per unit area is not dependent on the general concentration of amino-acids in the medium as represented by the Sörensen figure. This point is amply demonstrated by the figures given in Table I where the media described as *EDB/N* and *EDB/S* have the same Sörensen figure and only differ in that the latter contains an actually greater percentage of digest. (2) That, as has been mentioned already, and will be discussed in detail later, the killing power of a given strain of meningococcus has been observed to vary constantly with the medium on which it is grown. In the instance already mentioned the two media had the same Sörensen figure.

Since we are satisfied that a constant concentration of amino-acids in the finished medium, as expressed by the Sörensen figure, does not contribute to the stabilization of the culture either in respect of yield of growth or killing power, and as sufficient evidence to support this conclusion is to be found in Table I and Section V of this paper, no useful purpose would be served by detailing experiments.

It has been our experience that the amount of substances in the digest which are essential to produce the most efficient medium bear some relation directly proportional to the degree of digestion indicated by the Sörensen figure of the digest. We do not consider digestion to have proceeded sufficiently far for our purpose until a Sörensen figure of not less than twenty has been reached.

(*d*) *The Added Inorganic Salts.*

Among the characters used for the recognition of meningococcus colonies in cultures from the nasopharynx are the consistency of the growth and the ease with which it emulsifies. It is said that it "picks up like paint"; it ought to be soft and not stick to the medium, neither ought it

string out like mucilage nor be friable; and it ought to emulsify readily and evenly.

In working with pure meningococcal cultures isolated from cerebro-spinal fluids and grown on the many varying media we have made for experimental purposes, we have frequently obtained growths which exhibit those very characters the typical meningococcus is supposed not to possess. Quite commonly the growth is very slimy and difficult to remove from the surface of agar media and is very obstinate to emulsify in physiological saline. When picked up it strings out into an almost elastic thread and maintains that character when placed in saline, giving a very imperfect emulsion even after prolonged shaking. On the other hand, the growth may pick up quite readily but have a matt, granular appearance and when scraped into a heap the surface appears to be dry and wrinkled. This second type of growth gives a flocculent emulsion which very rapidly settles out of suspension. These are extremes which might be called the "sticky" and "granular" and can be produced by any given strain on two different media and be associated in each case with a very good yield per unit area. Somewhere between the two occurs the "characteristic" smooth, moist, flesh-coloured growth, which emulsifies easily and smoothly.

Microscopically no morphological distinction can be drawn between the cocci constituting the mass of growth exhibiting these various characters.

Possibly these observations explain certain disagreements in the literature.

Before entering into the details of our observations, as far as we have carried them, it is as well to draw attention to the remark of Nicolle, Debains and Jouan (1918, p. 151) that: "If it is desired thoroughly to know the macroscopical appearance of meningococci, it is necessary to examine them in a mass of several grammes."

There are two influences exercised by these physical characters exhibited by meningococcal cultures: The first is their influence upon the measurement of the growing power of a medium, and on this the "granular" type of growth has no effect, but the "sticky" kind is difficult to scrape up cleanly and without the risk of picking up pieces of medium or unduly squeezing moisture out of the agar. Although it only introduces a marked error in the case of extreme stickiness, it has the disadvantage of being difficult to manipulate. The second influence depends upon the imperfect emulsion the growth produces and has more profound effects upon general experimental work, such as inoculating animals or measuring quantities by a dilution method, etc., and this is particularly marked in the case of the rapidly sedimenting emulsion resulting from the "granular" kind of growth.

We first endeavoured to discover whether these physical characters of the growth were associated in any way with the frequently observed capsulated appearance of the cocci and the virulence of the culture, but we failed to find any such association. Since the virulence of a culture remained

unaffected by them it was desirable to eliminate the extreme variations, which were a source of trouble in the general experimental work, and we turned to the effect of varying the concentration of salts in the media. Although we do not pretend to have made a complete investigation of the influence of salts, we have obtained certain interesting results and to some extent we have succeeded in eliminating the extreme slimy and granular types of growth.

All the experiments now to be considered were made with media of the *EDB/S* type.

In the first place there were occasions when we accidentally omitted to add NaCl and $CaCl_2$ to the medium used for general work and confirmed their absence by titration subsequent to absolute failure to obtain growth on those batches, although other batches made with the same materials were satisfactory. These defective media gave the usual growth when we added the salts in the concentrations we then used (0·5 per cent NaCl, 0·0125 per cent $CaCl_2$). At this time we made our extracts with tap water. On one occasion we reserved a portion of the medium which gave no growth without and good growth with salts, added 0·0125 per cent $CaCl_2$ and varied the NaCl concentration with the following results:—

(1) 0·25 per cent NaCl gave growth which was not sticky and scraped well.

(2) 0·50 per cent NaCl gave growth which was moderately sticky but scraped well.

(3) 0·75 per cent NaCl gave growth which was sticky and scraped badly.

(4) 1·00 per cent NaCl gave growth which was very sticky and would not scrape at all.

Medium (3) gave very nearly half the yield per square centimetre given by media (1) and (2) which were approximately equal. This very definitely demonstrates that sticky growth can be due to a too high concentration of NaCl. Subsequent experiments showed that in the presence of 0·0125 per cent $CaCl_2$, when the extract has been made with tap water, the range of concentration of NaCl varying between 0·1 per cent and 0·3 per cent gave smooth moist growth and that stickiness commenced to appear with 0·4 per cent and increased with higher concentrations of this salt. No lower concentration than 0·1 per cent was tried at this time.

Without entering deeply into the question, we selected 0·25 per cent as the concentration of NaCl giving the most desirable form of growth for our purposes and then proceeded to test the effect of varying the concentration of other salts.

Media made with tap water extracts and containing 0·25 per cent NaCl without additional $CaCl_2$ invariably gave sticky growth and the following two experiments (Table IV) are instructive in showing that stickiness can be sufficiently inhibited by adding an appropriate amount of $CaCl_2$ and that an excess only increases this defect in the presence of NaCl.

TABLE IV.

Experiment	Medium No.	% NaCl	% $CaCl_2$	Character of growth	Regrowth in 9 hours over area scraped in morning
I	1	0·250	0	Sticky, scrapes badly, emulsifies easily	—
	2	0	0·0125	Smooth, scrapes well, emulsifies easily	—
	3	0·250	0·0050	Sticky, scrapes well, emulsifies easily	—
	4	0·250	0·0200	Slightly sticky, scrapes well, slightly stringy emulsion	—
	5	0·250	0·0400	Sticky, scrapes fairly well, stringy emulsion	—
II	A	0·250	0	Very sticky, scrapes badly	Grown well
	B	0	0·010	Smooth, scrapes well	Not grown
	C	0·250	0·005	Sticky, scrapes fairly well	Grown well
	D	0·250	0·010	Smooth, scrapes well	Not grown

It appears from these experiments that in the presence of 0·25 per cent NaCl the concentration of $CaCl_2$ required to give smooth moist growth is between 0·01 and 0·02 per cent and probably nearer the smaller figure. A result which we have confirmed using media made with distilled water extracts.

At the time of doing Experiment II (Table IV) we had become interested in the question of regrowth of the meningococcus over the area from which the growth had been scraped cleanly and in the appearance of secondary colonies superimposed on previously existing growth. The latter phenomenon had occurred very rarely and usually only after prolonged incubation on *EDB/N* media and was the rule with *EDB/S* media, when such media exhibited a difference in virulence in the cultures. We were inclined on that account to stress the importance of sterile digests (see Section VI) and it is interesting, therefore, to notice the inhibition of regrowth by 0·01 per cent $CaCl_2$ in Table IV.

Since we attach importance to regrowth as a criterion of a good medium, this effect of $CaCl_2$ caused us to try the effect of adding KCl to the medium; because of the high concentration of potassium salts described in actively growing malignant growths and the high concentration of those salts in egg-yolk; egg medium being one on which the meningococcus lives a very considerable time.

To an *EDB/S* medium containing 0·25 per cent NaCl and 0·01 per cent $CaCl_2$ we added KCl in varying proportions with the following results:—

(1) No KCl gave smooth growth and very slight regrowth.

(2) 0·01 per cent KCl gave slightly granular growth and very pronounced regrowth.

(3) 0·015 per cent KCl gave markedly granular growth and marked regrowth.

(4) 0·02 per cent KCl gave very pronounced granular growth and slight regrowth.

The regrowth in this experiment was noted after twenty-four hours' re-incubation, while in the $CaCl_2$ experiment (Table IV) it was noted after only nine hours' re-incubation. This experiment is interesting not only because it suggests that the potassium salt has some influence on the regrowth of

the culture over an area upon which it has already grown, but because the salt also appears to influence the production of the granular type of growth when both sodium and calcium salts are present. Further, when the NaCl and $CaCl_2$ are present in the proportion named above the optimal concentration of KCl is identical for both regrowth and the least granular type of growth.

In another experiment the medium was made with distilled water extract and the salts were added in varying proportions, but in no medium were more than two salts present. As far as possible all the other conditions were maintained alike for the different media and the results obtained are shown in Table V.

TABLE V.

Medium No.	NaCl %	$CaCl_2$ %	KCl %	Mean weight in mgms. of dried growth per sq. cm.	Mean dry growth as a % of the mean moist growth	Physical character of growth	Regrowth in 24 hours after scraping
1	0	0	0	0·525	17·1	Smooth	None
2	0·25	0	0	0·373	18·7	Very sticky	,,
3	0·25	0·005	0	0·375	19·4	Sticky	Very slight
4	0·25	0·01	0	0·563	19·8	Smooth	,,
5	0·25	0·02	0	0·445	19·6	,,	,,
6	0·25	0	0·01	0·511	19·3	Very sticky	Fair
7	0·25	0	0·02	0·431	19·7	,,	Very good
8	0·25	0	0·04	0·448	19·0	,,	,,

There are two points to be noted in comparing this with other experiments previously described: firstly, that the media were made with a distilled water extract; and secondly, that freshly laked blood was added as the accessory growth factor, which, as will be shown later, in common with fresh ascites fluid stimulates growth under otherwise unfavourable conditions, and probably accounts for growth being obtained on medium No. 1. This experiment suggests:—

(*a*) That the addition of NaCl causes stickiness which is counteracted by an optimal proportion of $CaCl_2$ and which is enhanced by adding KCl without $CaCl_2$.

(*b*) That the addition of KCl stimulates regrowth over the area from which growth has once been removed.

(*c*) That KCl in the presence of NaCl and the absence of $CaCl_2$ does not cause the growth to be granular.

We have not followed the question of the influence of inorganic salts as far as we would have liked, because it was not the primary object of our quest. We were mainly concerned with an attempt to render the conditions of growth such that the extremes of "sticky" and "granular" growth did not appear; for no other reason than that those extremes made our work more than ordinarily difficult. To some degree we have been successful, for, since adopting 0·25 per cent NaCl, 0·01 per cent $CaCl_2$ and 0·01 to 0·02 per cent KCl as the concentration of those salts to be added to a medium made with distilled water extract, we have not experienced

extremes of sticky or granular growth in other than experimental media to which excessively high concentrations of digest have been added.

Nevertheless, our investigation does not supply a complete explanation, for we possess one strain of meningococcus which is habitually slightly sticky on our ordinary media, though never unmanageably so, and we shall show that there are other influences than inorganic salts tending to cause stickiness.

It is expedient to be aware of the concentration of NaCl in the digest within reasonable limits. With all media made from one particular digest we were troubled with sticky growth, until we checked the concentration of NaCl it contained as the result of neutralizing the alkali which had been added in the course of digestion. On taking this into account and adding proportionally less NaCl to the finished medium, the growth obtained was of the desired consistency.

One other point deserves mention: the growth may be smooth and satisfactory when 12 to 16 hours old and quite noticeably sticky at 24 hours. In any case stickiness increases with age.

The killing power of the various strains used in these experiments was known and the growth yielded by these media, with varying concentrations of salts, gave no indication of variation in "virulence" for mice.

(*e*) *The Reaction.*

It would be misleading were we to state that the reaction of our medium is adjusted to a definite *p*H, since we have not taken into account the salt and protein errors and the titration has not been done at a constant temperature. At present we are content to adjust the reaction by a standard method whereby we do obtain fairly constant results, because our titrations have but slight variations which are well within the relatively wide range of tolerance of the bacteria to changes in the reaction of their environment and because comparatively large quantities of alkali or acid are necessary to produce a marked change in the reaction of the medium. The colorimetric method is employed, with phenol red as the indicator and we match our medium to standard Sörensen solutions of phosphates, superimposing a blank to compensate for the natural colour of the medium.

The medium is heated in a water-bath to melt it and drive off the CO_2 and one cubic centimetre in a cordite tube is diluted with four cubic centimetres of boiling distilled water. Two such tubes are prepared and to one of them the indicator is added in the same concentration as it is added to the tubes of Sörensen buffer solutions; the other tube is kept as the colour control. The diluted medium is made to match the buffer solution having a $p\mathrm{H}=7{\cdot}2$ and then it is boiled and cooled rapidly under the tap without shaking, before the final reading is made.

After the calculated amount of NaOH has been added to the bulk of the medium, we are careful to take a sample to check the reaction. Agar media which have been titrated when diluted to prevent too rapid setting

and to the bulk of which the calculated amount of alkali has been added, frequently are considerably on the acid side of the desired reaction. We have not investigated this point, nor do we offer any explanation, but we suggest that the omission to check the final reaction of the bulk of the medium has led to the statement having been made that ordinary media become increasingly acid with autoclaving. We have frequently autoclaved our finished media four and five times without the reaction changing in the process. On the other hand, if the desired reaction of the medium is more alkaline than that we require, then there is certainly a fall in the pH owing to the precipitation of phosphates, but it is not necessary to autoclave it in order to observe this change. When we have previously partially removed the phosphates from our media, we have usually found that the calculated quantity of alkali is sufficient to adjust the reaction to the desired pH. Liquid media (broth) do not behave in this peculiar way in our experience and the calculated quantity of alkali required to adjust the reaction to "pH 7·2" has always been correct, but, besides being free from agar, these media have not been diluted for purposes of titration.

The reaction we have selected is that which we found by experiment to yield maximum growth per unit area, and it is certainly rather more acid than the optimal reaction generally claimed for the meningococcus.

(*f*) *The Clarification.*

A perfectly transparent agar medium is so much a convenience as almost to be a necessity and is always preferable to another equally good in all other respects but this. When the extract and digest are clear to start with, there is little more needed to render the finished medium sufficiently transparent for almost all purposes, since the haziness due to the agar is but slight. But owing to the extract and digest being markedly acid the necessary adjustment of the reaction occasions a flocculent precipitate of phosphates to form, which if distributed through the medium interferes with its transparency. Although this precipitate readily deposits and the clear medium can be decanted off, an economy of time and medium can be effected by first filtering through ordinary surgical lint, which holds back the bulk of the precipitate as well as all the fine dirt in the agar. Were it not essential to add accessory growth factors to obtain cultures of freshly isolated or virulent strains of meningococcus, there would be no need to filter the medium at all. For a considerable time we met this need by adding freshly drawn horse blood which was coagulated by heat in the presence of the agar; this coagulum was removed most satisfactorily by filtration through lint, the medium held in the lint and clot was wrung out by hand, and the finished product was glass clear. The removal of this fine coagulum by filtration through paper is an extremely slow process and usually results in the loss of a considerable quantity of the medium.

Later, when freshly drawn horse blood was no longer available, we

evolved a process whereby the accessory growth factors are derived from the heart muscle used for making extracts and digests. The method will be described presently, but it is necessary to state here that an extremely fine coagulum is produced which is not removed easily by filtration through lint. However, we have found it to be more easily removed if it is produced and filtered in the presence of the glutinous phosphate precipitate, with which it seems to become entangled. We obtain this condition by adjusting the reaction of the medium to match the Sörensen solution of pH 7·6 (in the manner already described) before coagulation takes place. At this degree of alkalinity a copious precipitate of phosphates is produced which facilitates the removal of the fine protein coagulum by filtration through lint. The production of the phosphate precipitate reduces the alkalinity of the medium to some extent; so that the reaction now is usually that which we require for our finished product, namely, pH 7·2. The filtrate obtained in this way is quite sufficiently clear, but usually a slight haziness remains; this can be removed by filtration through paper or silted up lint if desired, but if some specially clear medium is required it is easily obtained by decanting the top layer which has cleared itself by sedimentation. That only a fraction of the phosphates in the medium is removed by this process is demonstrated by making the medium much more alkaline subsequently (pH 8·0 or 9·0), when a heavy precipitate is produced immediately.

But a word of warning is necessary since we have observed, when we have purposely poured into a plate a sample of medium containing a copious precipitate of phosphates and other matter, in such a way that the precipitate is not distributed evenly, that then the growth of meningococcus is much thicker over the dense precipitate than it is over the clear portions of the plate. In fact, when the accessory growth factors are derived from the heart muscle, there is no doubt that we get better results when the medium is slightly cloudy than we do when it is glass clear. When, however, the accessory growth factors are obtained by coagulating blood in the medium with heat, perfectly cleared medium is quite as efficient as that which is cloudy.

(*g*) *The Sterilization.*

We have not been able to detect any alteration in the finished medium, nor in the individual ingredients after repeated autoclaving at 120° C. for twenty minutes, as tested by the yield of growth and the killing power of the meningococcus. When the bulk of material to be sterilized in this way is large, we take the precaution of raising it to 100° C. in a water-bath or steamer before autoclaving it, otherwise the desired temperature is not reached and sterilization is incomplete. To test the temperature to which the material has been subjected we use pure chemical compounds of known melting point, enclosed in sealed glass tubes.

The statement has frequently been made, that, subsequent to autoclaving a medium, the reaction is more acid than it was to start with. We are emphatically of the opinion that this is not the case with media which

are not markedly alkaline and do not contain sugars. There are two conditions which we consider explain such observations, but we do not know to what degree they are interdependent: firstly, that the calculated quantity of alkali has been added to the bulk of the medium and the reaction has not been checked prior to autoclaving; secondly, that the formation of a copious precipitate of phosphates has separated in a markedly alkaline medium and in so doing reduced the alkalinity. In any case the second eventuality ought to be safeguarded against by resorting to the obvious expedient of checking the reaction before sterilization, and, if necessary, removing the excess of phosphates.

We have not been able to discover that repeated autoclaving produces any deterioration of the stimulus to growth due to the accessory growth factors which are essential to successful cultivation of the meningococcus.

(*To be continued.*)

THE SUPPLY OF MEDICAL EQUIPMENT IN PEACE TIME.

BY MAJOR D. P. WATSON, D.S.O.
Royal Army Medical Corps.

INSTRUCTIONS concerning medical equipment (the term now adopted to embrace all medical and surgical supplies) and for indenting for it are laid down in Regulations for the Medical Services of the Army. But regulations are dry things, and possibly an attempt to clothe their bare bones with the flesh of comment may not be out of place.

To commence with the process by which equipment is supplied.

Indents (A.F.I. 1,209) are prepared by the indenting officer in quadruplicate. He retains one copy in order to check the supplies when received and forwards three copies to the D.D.M.S. of the command, who, after scrutiny, countersigns the indent and, in turn retaining one copy, forwards the remaining two to the War Office.

Exceptions to this procedure are: (1) Indents for calf lymph are sent by the indenting officer to the Government lymph establishment at Hendon direct. (2) Urgent demands for sera or vaccines are mailed, telephoned or telegraphed direct to the Officer in Charge, Vaccine Department, R.A.M. College, Millbank, and a covering indent is at the same time forwarded in the usual manner. (3) In home commands, as an experiment, indents in duplicate for repairs to equipment already held on charge may be forwarded direct to the War Office, a copy being sent at the same time to the D.D.M.S. of the Command. In this way time is saved in repairing articles that have previously been sanctioned.

On arrival at the War Office (A.M.D. 3) indents are stamped with the date of receipt, entered in a register and given an issuing number. After scrutiny they are normally passed to the contractor for supply. At the present time they are first passed to the Officer Commanding Army Medical Store, Woolwich (where certain surplus stocks are still held) who strikes out items that he is able to supply before the indents are passed to the contractor.

The contractor (or O.C. A.M. Store) dispatches consignments direct to units at home, but in the case of units abroad he forwards a tonnage application to the War Office (A.M.D. 3) who arrange for shipment. A detailed packing invoice is then forwarded to the Command abroad by A.M.D. 3, who retain a copy in case of non-delivery of stores.

Small packages are sent by the contractor to A.M.D. 3 for dispatch by post.

The stores dispatched by the contractor for both home and abroad are accompanied by a blue packing invoice, which is used as a voucher to support the ledger entries of the unit concerned. At the same time the contractor forwards his bill in duplicate to the War Office, together with a duplicate

invoice. The invoice and one copy of the bill are then forwarded to the consignee, who passes the bill to the unit accountant and returns the blue invoice, duly receipted, to the War Office, together with the unit accountant's allocation statement.

On receipt by the War Office the receipted invoice is attached to the original bill, which, after audit, is passed to the Finance Board for payment. Delay in the return of the receipted blue invoice with the completed allocation statement, A.F.N. 7,503 attached, not infrequently occurs and causes extra work in the department and delay in settling the contractor's bills.

Consignments dispatched by the contractors are entered at the War Office in a register showing the issuing number, number of packages, date of dispatch, mode of conveyance, the date on which the blue invoice and bill are dispatched, and the date of recept by the consignee.

In the case of items supplied from A.M. Stores, Woolwich, or by one unit to another, A.F.I., 1,209 is used as an issue and receipt voucher. It is forwarded in triplicate to the consignee, who returns one copy, duly receipted, to the consignor, passes one to the unit accountant and retains the third to support the ledger entry.

All vouchers for stores should be priced.

All equipment received by a unit is entered in a ledger and a copy of the voucher filed to support the entry.

Indents are submitted half-yearly, as laid down in paragraph 290. Regulations for the medical services of the army. Supplementary indents should be accompanied by a covering letter explaining their necessity. A similar explanation is required with indents for equipment not included in the schedules laid down in the above regulations.

Delay in complying with indents sometimes occurs. It may be located in the office of origin, the office of the D.D.M.S., at the War Office, or at the A.M. Store or Contractor's. Inspection of the dates on an indent shows that delay, when it occurs is not always chargeable to the War Office, A.M. Store, or Contractor. Occasionally as many as three or four weeks have elapsed between the making out of an indent and its receipt by the War Office. Sometimes delay, especially in the repair of complicated and delicate instruments, occurs at the contractors.

A common cause of delay is the omission of necessary information with the demand. I may instance the following examples of omission:—

Weight of glass pan for scales and weights, pillar; size of surgeon's rubber gloves, and whether rough or smooth; dimensions of sterilizers, or size of washers for them; full particulars, and if possible catalogue numbers of special apparatus; covering letters for unusual demands. In the case of X-ray and electrical supplies particulars as to the nature of the local supply current. Items on an indent have occasionally been effaced by stamped impressions of the names of units, etc. Attention was drawn to this in a circular issued to commands instructing that indents should be stamped on the back and not on the face.

A.M.D. 3 have yearly to prepare an estimate of expenditure on medical equipment for the coming year for sanction by the Adjutant-General, before being passed to the finance branch, and expenditure must be kept within the limits of the estimate: or special sanction must be asked for further expenditure, and may be refused. It is, therefore, clear that expensive unforeseen demands cannot always be met immediately. And there are other reasons why indents cannot always be complied with.

I may state at once that the traditional—or mythical—attitude summed up by the dictum, "Don't let 'em 'ave it," does not exist, and that no demand is lightheartedly "turned down" by A.M.D. 3.

In almost every case where a demand is refused there is first a consultation with the appropriate branch of the Army Medical Department or consultant specialist. Demands are sometimes excessive or even fantastic. Thus a demand for twenty pairs of rubber post-mortem gloves for a station where the annual average number of deaths among soldiers is five, and where the climate causes rapid deterioration of rubber goods, was considerably cut down. And a demand for anti-tetanic serum for the treatment of a case of malaria was not sympathetically considered, though even then the Director of Pathology was consulted before it was refused.

Tablets of compressed drugs are not sanctioned for issue, on the ground of expense, unless there happen to be stocks available in A.M. Store, or unless they are required for replenishing field equipment.

Proprietary preparations are not usually refused when certified as necessary for the treatment of a case. But they are relatively expensive, and medical officers, before prescribing them, should make themselves acquainted with their cost, and more especially with their composition, and should exercise their ingenuity to produce the desired effect with the same or similar drugs in cheaper form. I would go further and say that they should study the cost of all drugs which they prescribe as carefully as they would were they engaged in private practice.

Recently a much-advertised preparation was, somewhat reluctantly, sanctioned on the special application of a medical officer. But since its sensational exposure by a leading daily paper the supply has necessarily been discontinued. It is the practice of the A.M.D., when sanctioning the issue of new preparations, to call for a report upon their action. Such reports serve as a guide to the advisability of their continued issue.

Again, indents may be refused because the items demanded are not a medical issue, or because there is no authority to issue them, e.g., indents for methylated spirit, or for milk-sugar required as a food, which are R.A.S.C. supplies, or for articles of Ordnance supply, such as slop-pails or bed-pans.

Frequently indents are received for spectacles for men who have already received one free issue, and are therefore not entitled to them, except on payment.

Careful scrutiny is exercised of indents for articles specially liable to

deteriorate, and indenting officers should be careful to avoid unnecessary accumulation of such items as organic arsenical compounds, rubber goods of all kinds and hydrogen peroxide. The latter is so unstable that it has been found to be impracticable to supply it to stations overseas, and a special A.C.I., No. 10, of 1920, has been published with the object of limiting its use.

In conclusion, may I emphasize the need of judicious economy, especially deprecating that form of waste which consists in the retention of expensive appliances in stations where they are no longer required, and of surplus stocks until they become unserviceable.

On the other hand, it is not at all desired that really unserviceable equipment should be returned to A.M. Store. Officers should not hesitate to use their powers under para. 317 Regs. for M.S. of the Army for dealing with it locally.

IV.—A CORRESPONDENCE CIRCLE.

By Major M. B. H. Ritchie, D.S.O.
Royal Army Medical Corps.

Officers' Messes of the Royal Army Medical Corps.

The matters on which brother officers have written or spoken about in connexion with the Circle are remarkably diverse. One which may interest everyone is a suggestion that our *Journal* should contain a series of articles illustrating the various Messes of the Corps. If I remember rightly, a description of the Mess at Hong-Kong appeared several years ago. Also, there was an article on the Talavera Cup. There seems to be ample scope for a series of interesting notes on Messes and their valuable contents. Millbank and Aldershot, Peshawar and Pindi—I do not think they have been written up. The trophies that adorn the Mess in Pindi, from the *Ovis Poli* head to the chair with a number on its back, acquired by No. 9 General Hospital at Bloemfontein; the beautiful centre-piece of Irish loving-cup design which, I trust, still graces the Mess table on guest nights; an account of these would be welcomed by every reader of our *Journal*. The original proposal, when the design for this centre-piece came under consideration, was a model of the temple of Æsculapius, or a representation of his son, Machaon, the first army surgeon recorded in history; but the silversmiths reported unfavourably, either on account of inartistic proportions, or of expense, and the cup was chosen instead. Let us hope that officers living in these Messes will be inspired to write them up. It is a bright idea.

Old Comrades.

A civilian *confrère* who has been a good friend to our Corps, mentions in a letter that he has noticed with regret how officers who retire early lose interest in the affairs of the Corps and of their old comrades. After the war, many of our brother officers "found their feet" professionally, and retired into practice or civil appointments; by inclination, or by force of circumstances, their activities were directed into new channels. I remember two senior officers discussing retirement, one stating that the best terms offered by Government were the pension of £1 a day after twenty years' service, because the officer left at an age at which his mind was flexible enough to make a success of civil practice—and prior to 1914 twenty shillings in twenty-four hours was a useful increment to the credit side of a pass-book. The second agreed, but pointed out how few took advantage of it, except the wealthy and the disgruntled.

This was many years ago, and times have changed; considerable numbers of our best men have gone, long before they need have done so. We must not lose touch with them, nor they with us. Dull cherry is

thicker than tweed. They are well placed in the matter of helping along the interests of the Corps, to which they may return in time of need, and which does not forget them. Though the exigencies of general practice and the complete change of work and environment tend towards an estrangement, let us not lose touch with each other. There is something in what my correspondent states, and it merits our attention.

How to be Called to the Bar.

Before the war, several officers of the Royal Corps were called to the Bar, and the following notes may prove of interest to those who have leanings in this direction. They have been contributed by a former D.A.D.M.S., 2nd Division, B.E.F., and Headquarters, London District.

The Call to the Bar.

By W. BENTLEY PURCHASE, Esq., M.C., M.A., M.B., D.P.H., Barrister-at-Law.

To be a barrister, it is necessary to become a student of one of the four Inns of Court, to "keep terms," to pass the necessary examinations, and to be "called."

Becoming a Student.—There are four Inns of Court, namely, Lincoln's Inn, the Middle Temple, the Inner Temple and Gray's Inn; the regulations regarding admission to them all have been consolidated and a copy can be obtained from the Inn chosen by the candidate. The writer does not desire to indicate which of the four Inns he considers preferable, but it is as well when deciding which Inn to join to have regard to any acquaintanceship the candidate may have with any bencher of an Inn or member of the Bar. This will be illustrated later under the heading of "Call."

The student must have passed a suitable entrance examination; of such examinations a list is given in the regulations, and this list includes "Any examination which entitles those who pass it . . . to a Commission in the Army or Navy." Therefore, from the point of view of the readers of this journal, the entrance examination has no terrors.

The student must fill up this application form and submit two separate certificates of good character from responsible persons.

He is then admitted a student, and must attend the Inn in person to sign certain documents.

"*Keeping Terms.*"—There are four legal terms in the year and these must be "kept"—that is, the student must dine in the hall of his Inn on six nights of each term. In passing, it may be pointed out that this is a means of getting an exceedingly good dinner, with wine, very cheaply.

As a student, the candidate must keep in all twelve terms (i.e., three years at least) before he can be called—though he may pass his examinations before then. The terms need not be kept in one continuous sequence.

Examinations.—To anyone who has wrestled with the examinations necessary to get a medical qualification, the mental effort of the examination for call to the Bar should not prove very great. It is true that at one

time the standard was a nominal one and that now it is definite, but if the aspirant has once an understanding of his subject the examination test is not exceedingly high.

The means of acquiring knowledge are:—

(1) Attending lectures given by Readers of the Inns.
(2) Private work.
(3) Coaching.

Lectures are given by the Readers in the lecture rooms of the Inns and are most useful if time can be given to them; it frequently happens, however, that the students attend none. There is no necessity to get "signed up" for them.

Private reading of various text-books is necessary in all cases, but of itself may not be very satisfying for the worker, who has no idea as to the extent or lack of his knowledge.

Coaching—either personally or by post—is a common means of preparing for examinations and is recommended to those who do not want to waste time and who can afford the expense.

The examinations consist of Parts I and II.

Part I includes:—

I. Roman Law.
II. Constitutional Law.
III. Criminal Law.
IV. Real Property or Hindo and Mahomedan Law or Roman Dutch Law } at the option of the student.

The part may be taken section by section at any time after admission as a student. No great depth of knowledge is required for a pass, but a good ground work is most useful later.

Part II includes:—

I. Common Law.
II. Equity.
III. Evidence and Civil Procedure.
IV. A general paper on I, II and III.

This part must be taken at once and after the student has kept at least six terms.

Fees.

On application for admission	£1	1	0
On admission (including two deposits: One of £100 returnable on Call, the other of £50 to pay for dinners, etc., the balance being returnable on Call). Admission fee, lecture fees and stamps, £58 13s. 3d. ...	£208	13	3
On Call	£112	0	0

The Call.—Having passed his examinations, the student must be called to the Bar by one of the Benchers of his own Inn, and it is here that it is helpful to know some Bencher. It is very tiresome to search hurriedly for some kindly disposed person.

After Call.—It was written elsewhere that "many are called and few are chosen." Getting called to the Bar and becoming a successful barrister are two things utterly distinct. It is essential to be a pupil (at a cost usually of 100 guineas for twelve months) in good chambers—Mark Twain pointed out the care with which one should choose one's parents, and this is analogous to the period as a pupil. Some go as pupils from one set of chambers to another, and this is a good plan. For instance, six months in good criminal chambers, followed by or preceded by six months in general common law chambers, are a good combination. After this period (and rarely during the course of it) briefs may or may not come. In general, at the present time, anyone of average ability as a barrister may safely budget on living on air more or less for the first five years after call, and, during that time, to spend in expenses in chambers about £100 a year; though, after the third year, he may hope to be recovering in fees a fair proportion of this latter expenditure. It depends on many factors, and the figures are given as an indication of what may reasonably be expected.

For the information of those who desire to take up law, the addresses to which written application should be made in the first instance are given :—

The Under-Treasurer, Lincoln's Inn, London, W.C. 2.
The Under-Treasurer, Middle Temple, London, E.C. 4.
The Sub-Treasurer, Inner Temple, London, E.C. 4.
The Under-Treasurer, Gray's Inn, London, W.C. 1

Notes on Military Law.

The following notes on Military Law, contributed by an officer of the Royal Malta Artillery, wil be of considerable use to anyone who may be called upon at short notice to prepare applications for Courts Martial, or for examination purposes. It applies more particularly to the case of a soldier who has committed an offence which can be dealt with by his commanding officer, but who has elected trial by Court Martial.

Applications for Courts Martial.

Pages quoted are in Manual of Military Law.
702-704, very important.

Forms to be Rendered.

1. Application for Trial. (A.F.B. 116.) — Manual Page 727
2. Charge Sheet in Duplicate. (Manuscript.) — Page 659
3. Summary of Evidence. (Original and 1 Copy.)
4. Regimental and Company Conduct Sheets.
5. List of Witnesses for Prosecution and Defence (Manuscript) (showing present stations, in duplicate).

6. Statement as to Character and Particulars of Service of the accused. (A.F.B. 296.)
7. Statement in writing by accused whether or not he wishes to have an Officer assigned for "Defence" (Manuscript). (See R.P. 13a and 87a.)
8. Certified true copies of any papers or documents to be produced. (In certain cases, originals are required: see pp. 523-526.)
9. A.F.B. 115 in case of Desertion.
10. Certificate in case of written "Statements of Evidence" where:—
    (i) Witnesses cannot attend. (R.P. 4 (g).)
    (ii) Witnesses not subject to Military Law do not attend. (R.P. 4 (h) and 4 (g).)

Notes re Forms, etc., submitted.

A.F.B.116. (*Application.*)

(*a*) If accused has elected trial, fact should be recorded at top of form (in red ink).

(*b*) If Court of Inquiry is held, members detailed should be different to those *investigating* the case.

(*c*) The name of the Prosecutor to be stated. (Not necessarily the Officer who took down the Summary of Evidence.)

(*d*) Form to be signed by the Commanding Officer himself.

(*e*) Medical certificate to be completed. (If *possible*, Medical Officer not to be one of those investigating the case, or Prosecutor.)

Conduct Sheets.

Ensure: (i) K.R. 1708 is complied with.

(ii) Offence not already dealt with.

(iii) In cases of Drunkenness, that the soldier is liable to be Court Martialled. (K.R. 572 especially, also 569-573. *re* N.C.O.'s, see page 21, rule 26.)

Charge Sheet.

(i) If elected trial, fact must be clearly stated at top of sheet in red ink. (Page 703, rule 2 (j).)

(ii) Sufficient space left at foot of sheet for orders of Convening Officer to be entered. (Page 703, rule 2 (h).)

(iii) Permanent Rank of accused to be stated, with acting rank (in brackets) following permanent rank, e.g., Corporal (Acting Serjeant), etc.

(iv) Form and wording of *Charge* to be in accordance with specimens on pp. 649-676. (See page 703, rule 1 (e).)

(v) The Section of the Army Act to be entered in the margin, in red ink, opposite charge to which it refers. (Page 703, rule 2 (1).)

(vi) If accused has elected trial, "*Charge*" as read out to the accused from the Guard Report, cannot be added to or increased in gravity. (Page 703, rule 1 (f).)

(vii) *Re* alternative Charges. (See pp. 438, 436.)
Re separate Charge Sheets. (See pp. 610-612.)

(viii) Insure that :— (Pp. 702-703, rule 1 (a) to (f).)

(*a*) Accused is charged with an offence which is an Offence against the Army Act.

(*b*) Accused is not exempt from trial under A.A. 161 or R.P. 36 (a).

(*c*) Offence is not one of those in K.R. 543, to be dealt with by Commanding Officer, unless there are special circumstances, or accused elects trial.

(ix) In case of "deficiencies," "losses" or "damages," actual value of each item of *Public Property* to be quoted in words and figures. (K.R. 623.)

(x) Sheet to be signed by Commanding Officer himself.

Summary of Evidence : May be taken on *Oath* (R.P. 4 (f)).

1. Each statement to commence with :—
No...... Rank......... Name......... Unit......... (or appropriate particulars).
States :—
Place......... Date...... and Time (if material). (Page 703 rule 2 (1).)

2. Statements for prosecution are taken down first :—
Then for Defence, unless reserved. (R.P. 4 (e).)
(See amendments to R.P. 4 (e) by A.O. 439/1920.)

3. Signature of Witness (or mark attested) after each statement (including cross-examination if any). (R.P. 4 (e).)

4. *Re* written statements of Persons who do not attend for summary. (See R.P. 4 (g) and (h).)

5. *Evidence.*

(*a*) Inadmissible : If irrelevant. (Page 703, rule 2 (b).
If hearsay. (Page 59, rule 15.)
If opinions, suspicions, surmises (ditto).
If reference to previous offence, unless directly connected with present offence. (Page 60, rule 20.)

(*b*) Secondary : see pp. 63 and 64.

(*c*) Refreshing Memory : see pp. 73, rule 70.

(*d*) Confessions : see pp. 68, 73-75.

(*e*) Documentary : Statement of person *producing* documents should be included. (Page 703, rule 2 (k).)
Any "Certified copy of Order, etc.," which it is intended to produce to the Court Martial, must be produced in evidence in the Summary.

(*f*) Must be sufficient to justify trial on the *Charge* made. (Page 703, rule 1 (d) ; also R.P. 5.)

(*g*) In case of Desertion, A.F.B. 115 (or A.B. 161) will be required. (Page 639, note 3, last sentence.)

(*h*) In case of "deficiencies," evidence required that:—

(i) Accused was in possession of a complete kit, or articles deficient, at some time previously.

(ii) Proper inventory was taken, when deficiency was discovered, and total deficiencies noted.

(iii) No articles, found deficient at taking of inventory, have since been found. If any found, state circumstances; if no blame *re* deficiency attaches to the accused, strike out the charge.

(iv) If articles are *Public* property, actual value of each to be stated. An official required with priced vocabulary to give evidence. (K.R. 623.)

(v) In case of "damages," *expert* evidence required.

6. *Concluding Para.*

Taken down by me in the presence of the accused, who was given every opportunity of cross-examining the witnesses at .... this ...... day of .... 19......

Signature of Officer taking Summary.

Before investigating the case, the C.O. should consider whether the Offence is likely to require a *Summary* Punishment.

If he thinks so, it is very necessary to ensure that:—

The form and wording of the charge, as read out from the Guard Report, are in accordance with specimens on pages 649-676, 659, Manual of Military Law. (See also K.R. 543.) See Manual of Military Law, p. 703, rule 1 (f).

SOME FURTHER NOTES ON CRESOL AS A LARVICIDE.

By Major J. E. M. BOYD, M.C., F.E.S.
Royal Army Medical Corps.

I have read with great interest the article by Lieutenant-Colonel C. W. Holden, R.A.M.C., on "The Prevention of Malaria with a Division in the Field," published in the Corps Journal for April, 1924, but from experiments we have made, consider that, before cresol is recognized as an efficient larvicide, further work should be carried out, as local results do not in any way agree with those reported by Major Mayne, R.A.M.C.

The A.D.M.S., Lahore District, in his letter No. 6767/124 Medical, dated May 26, 1924, asked for experiments to be carried out in all hospitals in the district.

The following experiments were carried out at Dagshai, a hill station, but owing to larvæ being scarce and hard to find, all had to be performed under "laboratory conditions," no large area of water being available for the purpose.

(1) Commenced at 11 a.m. on June 11, 1924. Second and third stage larvæ and pupæ being used. (*a*) 1 in 1 million cresol in tap water; (*b*) 1 in 10 million cresol in tap water; (*c*) control in tap water; (*d*) control in rain water. Dry cow-dung being used as food.

June 12, 1924.—One larva dead in (*a*), all others alive and healthy.

June 13, 1924.—One pupa dead in (*b*), adults emerged in (*a*) and (*c*).

June 17, 1924.—All larvæ had pupated and most pupæ had emerged as adults. Exception was taken to this experiment, as only large larvæ and pupæ were used, ova and early stages not being available, but under natural conditions one cannot arrange to deal with only one particular stage.

(2) Commenced at 10 a.m. on July 11, 1924. Newly emerged larvæ only used. (*a*) 1 in 500,000 cresol in rain water; (*b*) 1 in 1 million cresol in rain water; (*c*) 1 in 10 million cresol in rain water; (*d*) control in rain water. Food supply as before.

July 12, 1924.—Larvæ alive in all bottles.
July 15, 1924. ,, ,,
July 20, 1924. ,, ,,
August 2, 1924. ,, ,,
August 11, 1924. ,, ,,
September 11, 1924. ,, ,,

October 3, 1924.—One larva still alive in (*a*), nothing in (*b*), (*c*) and (*d*). This experiment is of interest owing to the long time the larvæ lived without developing. Most of them died off in the second stage, the last survivor reached the third stage. The addition of cresol had nothing to with this

delay in development as the larvæ in the control jar developed in the same way as the others, most probably cold being the cause as this experiment was carried out in the rains.

(3) Commenced at 10 a.m. on July 31, 1924, all stages were used. (*a*) 1 in 500,000 cresol in rain water; (*b*) 1 in 1 million cresol in rain water; (*c*) 1 in 10 million cresol in rain water; (*d*) control in rain water. Food supply as before.

August 2, 1924.—All larvæ alive.

August 4, 1924.—All larvæ alive, some pupated.

(4) Commenced August 2, 1924, at 11 a.m. all stages. (*a*) 1 in 100,000 cresol in rain water. (*b*) 1 in 250,000 cresol in rain water. (*c*) Control in water. Larvæ in (*a*) all died in about three hours.

August 3, 1924.—Larvæ in (*b*) and (*c*) alive.

August 18, 1924.—The last of the larvæ emerged from the pupal stage in jar (*b*). All the above experiments were carried out with culex larvæ, no anopheline larvæ being available in Dagshai.

(5) Commenced on September 18, 1924, at the British Station Hospital, Lahore Cantonment. Larvæ of *Anopheles rossii* put in 1 in 250,000 cresol in tap water, with green weed as food.

September 19, 1924.—Larvæ alive, one pupated.

September 23, 1924.—All larvæ have pupated, one adult in dish.

September 24, 1924.—Remaining pupæ emerged. The figures given in the original article were as follows:—

Cresol	Water	Dilution	Result
1 oz. ..	1 cub. ft. ..	1 in 1,000 ..	Killed in 2 mins.
1 ,, ..	10 ,, ..	1 in 10,000 ..	Killed in 15 ,,
1 ,, ..	100 ,, ..	1 in 100,000 ..	Killed in 1 hour
1 ,, ..	1,000 ,, ..	1 in 1 million ..	Killed in 4 hours
1 ,, ..	10,000 ,, ..	1 in 10 millions ..	Killed in 12 ,,

This was not borne out in the above experiments.

By the kindness of Major A. C. Hammond Searle, M.C., R.A.M.C., D.A.D.M.S. (San.), Lahore District, I was allowed to see all the reports sent in from various stations in the district. Some results agreed with those given by Major Mayne, others did not do so. At the British Station Hospital, Multan, the following results were obtained:—

1 in 1,000 killed in 90 seconds.
1 in 10,000 killed in 6 minutes 20 seconds.
1 in 100,000 killed in 36 minutes.
1 in 1,000,000 killed in 6 hours.
1 in 10,000,000 failed in 36 hours.

At the British Station Hospital, Ambala, the results were:—

1 in 1,000 killed in 50 seconds.
1 in 10,000 killed in 12½ minutes.
1 in 100,000 failed.
1 in 1,000,000 failed.
1 in 10,000,000 failed.

At another British Station Hospital the report showed that:—

1 in 1,000 killed in 65 to 70 seconds.
1 in 10,000 killed in 14 to 16 minutes.
1 in 100,000 alive in 36 hours.
1 in 1,000,000 failed.
1 in 10,000,000 failed.

British Station Hospital, Ferozepore, reported:—

1 in 1,000 no record.
1 in 10,000 failed, presumably in the time stated.
1 in 100,000 failed.
1 in 1,000,000 failed.
1 in 10,000,000 failed.

The report from another British Station Hospital, was that:—

1 in 1,000 no record.
1 in 10,000 killed in two hours.
1 in 100,000 failed.
1 in 1,000,000 failed.
1 in 10,000,000 failed.

The British Station Hospital, Dharamsala, stated, "Crude oil better." And finally the British Station Hospital, Jullunder, reported that it was "Not much use."

There is no doubt that the very strong solutions of cresol will destroy larvæ, but until further experiments are carried out it is unwise to take it for granted that any solution weaker than 1 in 100,000 will prove of use.

An efficient larvicide is needed to destroy the thousands of larvæ found in most cantonments. So far the mixture of kerosene and crude oil has been found the best for ordinary use, but of course cannot be used for drinking water. To prove of any use the larvicide needs to be tasteless and non-toxic to men and animals.

Anti-malarial squads in India do their best, but their efforts are primitive, owing to lack of funds, and must continue to be so until more funds are available to allow for much-needed major works to be carried out.

Clinical and other Notes.

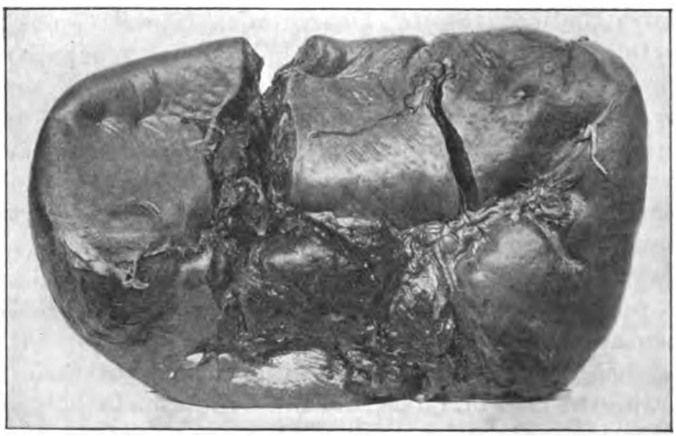
A CASE OF LACERATION OF ENLARGED MALARIAL SPLEEN, WITH RUPTURE OF THE VESSELS AT THE HILUM. SPLENECTOMY. RECOVERY.

By Major H. C. SIDGWICK, O.B.E.
Royal Army Medical Corps.

At 10 p.m. on September 8, Trpr. A. B., 3/6th Dragoon Guards, was bicycling with a friend about 7 miles from Colchester. In the dark he collided with the pavement and was thrown forcibly against the handle bar, the left handle striking him in the left upper abdomen.

Feeling very ill, he lay down by the side of the road, while his companion went to seek help.

An ambulance was obtained, and Trpr. A. B. was taken in it to Colchester, arriving at the Military Hospital at about 3 a.m. on September 9.



On admission he appeared ill, and was moderately blanched, his temperature was 99° F., and his pulse 104. He complained of great pain in the abdomen, which was tender and rigid; he vomited once.

Examination of his Medical History Sheet showed that he had suffered from benign tertian malaria in India in 1923, and had had several relapses.

At 9.30 a.m. on September 10, the pain was less acute, his temperature was 99·2° F., and pulse 84. The abdomen was still rigid.

A fullness could be felt in the left flank, but no evidence of shifting dullness was obtained.

The presence of a rupture of the spleen was suspected, but the diagnosis being uncertain, the patient was carefully watched for the next few hours, the pulse and temperature being taken every hour.

At 3 p.m. the temperature had risen to 101·4° F., the pulse to 96, and respirations to 40. The patient was complaining of great pain both in the abdomen and left shoulder, and the abdomen remained rigid.

Operation 5 p.m. Anæsthetic—chloroform ether mixture—administered with the Shipway apparatus.

The abdomen was opened through the outer portion of the left rectus sheath and was found to be full of blood. The spleen was felt to be much enlarged. The incision was then enlarged by prolonging it along the left infracostal margin, and the spleen brought up into the wound.

Two deep lacerations were found, the larger of which extending right across the visceral surface and involving the hilum: the vessels of the hilum were ruptured, so that the speen was lying almost free. It was removed and the free blood in the abdomen sponged away.

A rapid search was made for the vessels as the hæmorrhage was very violent. The tail of the pancreas was found and clamped together with the gastrosplenic omentum, lieno-renal ligament and the splenic vessels.

The abdomen was sponged free of blood, and the hæmorrhage appeared to have been controlled. Interlocking ligatures of strong catgut were applied, the tail of the pancreas being included in the ligatures.

The abdomen was then closed.

The patient was collapsed after the operation.

Rectal salines and pituitrin were administered four-hourly through the night.

He vomited clear fluid several times.

On the following morning his temperature was 99·4° F. and pulse 84 and the abdomen moderately distended.

On September 11, the abdominal pain and distension were marked and greenish fluid was vomited.

A turpentine enema was given.

At 6 p.m. the temperature rose to 101° F.

Ten grains of quinine bihydrochloride was given intramuscularly and 1 c.c. of omnopon hypodermically.

On September 12, the abdominal pain and distension were less and vomiting ceased. Temperature 99° F. and pulse 88. The patient was able to take fluids, and quinine by the mouth.

On September 13 and 14, he felt more comfortable, but the temperature rose in the evening to 101° on the 13th and to 102° F. on the 14th.

On September 15, he felt better, his temperature fell to normal and his pulse to 80.

There was no abdominal distension and he was able to take fluids and egg flips.

The quinine was continued.

On September 17, the stitches were taken out and the wound was healed. Temperature normal.

Fish, eggs and bread and butter were given.

Blood examination.		Differential.	
Hæmoglobin	60 per cent.	Polymorphonuclears ..	86 per cent.
Colour Index	0·7	Lymphocytes	11·5 „
Red blood corpuscles	4,500,000	Large mononuclears ..	2 „
White blood corpuscles ..	21,000	Eosinophiles ..	5 „

On September 29, the patient was feeling well, but there was slight gaping at the lower end of wound. Otherwise condition normal and satisfactory.

October 8. The wound was practically healed and the patient's condition satisfactory.

Blood examination.		Differential.	
Hæmoglobin	64 per cent.	Polymorphonuclears ..	50 per cent.
Colour Index	0·7 „	Lymphocytes	35 „
Red blood corpuscles	4,580,000	Large mononuclears ..	14 „
White blood corpuscles ..	10,600	Eosinophiles	1 „

Benign tertian malarial parasites present in large numbers in pre-sporulating stage.

October 9. The patient had a rigor and a typical attack of malaria.

Quinine was given by the mouth,

October 12. Temperature normal and the patient feeling well. His wound has healed. He was allowed "up" in the evening.

October 17. The patient was up all day, feeling well and taking full diet.

Pathological Report on Spleen.—The organ is greatly enlarged and shows several lacerations which extend deeply into the splenic pulp.

Its weight is markedly increased, being 520 grammes, in contrast to the normal, 155 to 195 grammes.

Histologically, the usual changes found associated with chronic malarial infection are evident. The capsule and fibrous trabeculæ are hypertrophied and thickened.

There is a definite increase in the stroma and granules of pigment—hæmozoin and hæmosiderin—are a feature in the section.

The writer is indebted to Lieutenant-Colonel E. V. Aylen for his permission to report this case, and to Lieutenant-Colonel H. M. Perry for the pathological report and for the photograph of the spleen.

A CASE OF SNAKE BITE IN A DOG TREATED WITH ANTI-VENINE SERUM.

By Major E. B. LATHBURY, O.B.E.
Royal Army Medical Corps.

Although many people die of snake bite in India comparatively few of us ever see cases and fewer still have an opportunity of observing the effects of anti-venine serum. The following note of a dog treated with the serum may therefore be of interest:—

I was having my breakfast preparatory to going to the hospital one morning when a brother-officer in the Indian Army living opposite came in

and asked me if I could do anything for his dog—a spaniel—who had just been bitten by a snake. As he said the snake had been killed there was no doubt about the diagnosis.

The dog had a punctured wound over the right eyebrow which was slightly swollen and from which the blood was oozing, the dog was wagging his tail and beyond looking a little depressed there did not seem much amiss.

As I had more than one tube of serum available I considered it justifiable to try the effect on the dog, which was put in my side-car and taken forthwith to the hospital, where I injected about fifteen cubic centimetres into each flank, the dog making no objection to the operation.

There was a delay of about two minutes in finding the person who had the keys of the snake bite emergency box, which led me afterwards to substitute a seal instead of a lock for this box.

Within a few hours there was considerable swelling in the head and around the region of the bite, deglutition was very difficult and for some days the dog was practically unable to take any nourishment, and became reduced to a skeleton. In the course of some weeks the symptoms gradually subsided and no further specific treatment was adopted.

About two months after the region around the affected eye became quite bald. The dog is now in perfect health. The snake was identified as a "pitless" Russells viper, about three feet in length.

I am indebted to Major-General D. J. Collins, C.B., C.M.G., D.D.M.S., Southern Command, for the suggestion to make this note, as showing the efficacy of the serum. I may state that the interva from the time of bite to the time of injection was about ten minutes.

A CASE OF *CYSTICERCUS CELLULOSÆ* IN MAN.

By Captain J. ROWE.

Royal Army Medical Corps.

In view of the rarity of this infection I venture to report a case which has been admitted to the Citadel Military Hospital, Cairo.

The patient, a man, aged 22, had been infected with *Tænia solium* in February, 1923, and cured, the worm was expelled and no segments had been found in the stools since then.

Early in July this year he noticed a small lump in the subcutaneous tissue over the temporal bone, and this was succeeded by several similar lumps distributed over the face, abdomen and arms. On admission to hospital one of these was excised, and proved to be a *Cysticercus cellulosæ* of *T. solium*. Since then cysts have appeared in various situations in the subcutaneous tissues of the head, arms and trunk; they were first observed when they had grown to the size of a pea, and in about seven days they

grew to nearly twice this size, after which time they were quiescent and did not cause the patient any inconvenience. There has been no regularity in growth, two may appear on the same day and then a week passes before another is observed, and there has been no symmetry of distribution. As far as can be ascertained they have not infected any tissue except the subcutaneous tissue. The fundi are normal, but the acuteness of vision is not so good as on enlistment, due to myopic astigmatism.

The blood on admission to hospital showed no increase in eosinophilia, and the cerebro-spinal fluid was normal.

Mode of Infection.—As early as 1855 it was established by Küchenmeister that auto-infection can occur, that is to say that a patient harbouring tapeworm can infect himself with *Cysticercus cellulosæ.* This may occur by (1) the fertilized ova being regurgitated into the stomach in the act of vomiting, or (2) by the patient contaminating his food. All that is necessary is to introduce the ova into the stomach, where the shell is dissolved by the acid gastric juice, thus liberating the embryo. Man is credited with an immunity against invasion, and the true intermediate host is the pig.

Symptomatology.—The following extract from "The Animal Parasites of Man" (Stephens and Theobald) has been borne out in the present instance. The characteristics of the subcutaneous tumours are :—

(*a*) Position in the subcutaneous connective tissue.

(*b*) Approximately equal size and regularly rounded form.

(*c*) The peculiar density, almost reminding one of cartilage in its hardness and the sensation of tightly distended thick-walled bladders.

(*d*) Proportionately slight mobility.

(*e*) Painlessness and the absence of cutaneous reaction over the tumour.

In cases previously reported it was observed that the cysts were symmetrically arranged, often following the course of a nerve and leading to a diagnosis of neurofibromata, the head and neck and upper part of the trunk are most frequently affected, the brain and spinal cord are often the site of infection. The symptoms usually presented are fits of a non-epileptiform nature, accompanied by vertigo and detachment of the retina.

As the cysts may affect any part of the body the chain of resulting symptoms vary enormously, and, in general, consist of pressure symptoms of the infected organ. The blood is the most constant sign and almost invariably shows a marked eosinophilia with a leucopenia.

Diagnosis.—(1) The character of the tumours when found in the connective tissue. (2) The constant eosinophilia ; 20 per cent and upwards. (3) Fits and Vertigo. (4) History of previous infection by *T. solium* or discovery of segments in the stools. (5) Pressure symptoms and impairment of function when the cysts are not accessible would be a warning of the possibility of infection. The diagnosis is made by excision and examination of the cyst.

Treatment.—On the whole is unsatisfactory. The possibility of the

patients harbouring the *T. solium* should not be overlooked, and after the routine *Filix mas* treatment a careful examination of the stools should be made.

The following lines of treatment have been tried without much success:

(1) Injection of neokharsivan and tartar-emetic intravenously.

(2) Small doses of anthelminthics combined with potassium iodide and calcium salts internally.

(3) Local treatment of the accessible cysts by injection of one minim one per cent solution of hyd. percholor.

A complement-fixation test, using the fluid from the cyst as antigen, proved a failure in the case recorded.

Prognosis.—The cysts may take up to twelve months to develop—beyond that period further development is rare—and they rapidly diminish in number, thus after a twelve months' history prognosis is good, provided that the brain is not involved. Failure to find eosinophilia in the cerebro-spinal fluid is a point against central nervous affection.

I am indebted to Lieutenant-Colonel L. Wood, R.A.M.C. Officer Commanding Citadel Military Hospital, for permission to publish these notes.

Travel.

A TOUR IN PALESTINE.

By Major N. LOW, D.S.O.
Royal Army Medical Corps.

It may possibly be of some interest to my brother officers to have particulars of a trip round the holy places of Palestine. This country, though becoming much easier of access, is still rather off the beaten track for the R.A.M.C., and since it is now under the administration of the R.A.F., our officers are no longer stationed there.

The best time of year for making a tour of Palestine is during February and March. The rains are then more or less over, roads are passable, and the country is one mass of flowers. Narcissi, anemones, ranunculus, delphinium, poppies, lupin, etc., grow in profusion, while in places the very rare black iris can be found. There are two main routes to the country; one, the usual, through Port Said, and the other by the Prince, or Messageries Lines, to Jaffa. At the latter port, there being only an open roadstead, it is often impossible to land in rough weather, and I shall take it for granted that the Port Said route is chosen.

We all know Port Said, and the only remark one need make is to the effect that it is worth while to go ashore in uniform if you have much baggage or anything you hesitate to bring before the inquisitive eye of the

customs officer. The same applies to the customs at Kantara, where you change for Palestine. (N.B.—A fairly heavy duty is charged on cameras.)

Tickets can be taken from Port Said to Jerusalem. Fare about £8. A sleeping berth should be wired for to Kantara. This costs £1 5s. extra, but it is well worth while. Passports should be given to the attendant, as otherwise you are roused out of your slumbers at 11.45 to show them.

The mail leaves Port Said at 6 p.m., and we arrive at Kantara at 7.30 p.m. Dinner can be got on the train, but as the Palestine train does not leave till midnight it is as well to have it in the hotel at Kantara, as there is absolutely nothing to do unless one has a taste for moralizing amongst the masses of rusty barbed wire, derelict lorries, and broken incinerators which are the chief features of the landscape. Even an Eastern moon cannot tinge them with romance.

The mail reaches Ludd at 8 a.m., and here we find ourselves in the Jaffa orange country, which at this season of the year are at their best. Great piles of them are seen at every tiny station awaiting transport to Egypt. The best are more carefully packed and sent by sea from Jaffa.

At Ludd our carriage is switched and attached to the Jerusalem train. Jerusalem is reached about 10.30 after a most interesting run up a very steep track. Nowadays the engines are sufficiently powerful, but in 1919 it was often a little doubtful as to whether the train would take charge and career backwards in spite of the efforts of the engine.

There are two hotels in Jerusalem, the Allenby and the Grand New; both are moderately comfortable, but it may be noted here that hotel accommodation in Palestine is much behind the times. Prices run from 25s. to 30s. a day. After settling in, the tourist will want to go round the objects of interest, and as time is probably an object he had better get a guide. The hotel will find one. They are all very voluble, more or less accurate, and have an exaggerated idea of their own value.

The Church of the Holy Sepulchre is the first of the Holy places to which one will be taken, and I think one's first feeling will be one of intense disappointment. The style of decoration is too ornate and tawdry to suit English ideas. There is a lack of the dignity one associates with a church of its importance, and there is an atmosphere of "on the make" which to me was very repugnant. The Latins, Greeks, and Armenians all have chapels within the Church, and are continually quarrelling among themselves, each trying to obtain a little more space at the expense of their neighbours. In Turkish times an armed guard was maintained to keep the peace between them.

It is also somewhat of a strain on one's religious ideas to find the traditional sites of so many of the spots connected with our Lord's Crucifixion under one roof. It is hard to believe that the sites of the Scourging, Calvary and Sepulchre could all be found within approximately fifty yards, but that is a point which the visitor must consider for himself. St Helena's Chapel is interesting and probably authentic. The cave is

also shown in which she is said to have seen the True Cross in a dream. On leaving, take a look at the Crusaders' tombs just outside the entrance. You will next be taken to the Jew's Wailing Wall. The largest number of mourners assembles on a Friday, but some are always there. The wall, I believe, is said to date back to the times of Solomon. It is certainly of great antiquity. I have been told that, before the war at any rate, a large proportion of the Jewish population of Jerusalem consisted of Jews maintained by the wealthy Jews of Europe for the purpose of wailing at the wall. I cannot vouch for the accuracy of this.

The Mosque of Omar (Dome of the Rock) is close to the Wailing Wall, and the visitor will be taken there next. It is on the site of Solomon's Temple, and is a magnificent structure. With the exception of a large mass of rock arising through the floor, it is absolutely unfurnished, priceless carpets excepted, and with its dim religious light and air of simple dignity, compares most favourably with the Church of the Holy Sepulchre. The rock in the centre has a small cave beneath, in which Abraham is stated to have slept, whilst Mahomet is reputed to have started for Heaven from the summit. A footprint of the latter is shown. If authentic, he must have been above the common stature. Deep blue tiles, with quotations from the Koran in gold, encircle the dome within and without, and the whole effect is most impressive. A fine view of the Mount of Olives, Mount Scopus, and the Valley of Jehosophat is obtained on one side, while the packed roofs of the native town are seen on the other.

The Mosque of Aksa, situated in the same courtyard, is also well worth a visit.

Whilst in this neighbourhood Pilate's Judgment Hall, which has recently been cleared, and the Via Dolorosa should be visited.

Space hardly permits of the description of many other spots of interest which should be visited. The Garden of Gethsemane, with its olive trees of extreme age, and which may have actually been growing in the time of Our Lord; the Mount of Olives, Tombs of the Kings, Room of the Last Supper, Solomon's Stables, etc., are all within easy distance. Jerusalem, in fact, is a very compact city, and all the points of interest, except perhaps the Mount of Olives, are within easy walking distance. A walk round the Walls of Jerusalem at sunset is worth doing.

When the visitor has seen the city itself, he should, if possible, visit Bethlehem, with its Church of the Nativity, Bethany where the House of Lazarus is shown, Hebron and Jericho.

The Church of the Nativity is a fine one, though spoilt, to my mind, by over-ornamentation. A large silver star is let into the floor over the spot where Christ is said to have been born. The cave in which the actual birth took place is immediately beneath. The small size of the church door should be noticed. This was done to prevent the Turks from stabling horses in the church. The Latins, Greeks and Armenians have chapels in the church, as in the Holy Sepulchre, and are equally quarrelsome.

There is an interesting tradition that the Holy Family left the stable after a short time, and took shelter in another cave in the village. Here Mary, whilst suckling the Holy Child, spilt a little milk, and a jet of milk has gushed from the cave wall ever since. There is certainly a trickle of water rendered milky by lime. This is made up into little tablets with stone from the cave and sold as a lactagogue, with reportedly excellent results.

The traditional site of the visitation of the Shepherds is shown, luckily close to the village.

If time is available, a large mother-o'-pearl factory is worth a visit.

Sight-seeing in Jerusalem and Bethlehem should take about three days, and the visitor, if he can spare time, should now think about seeing the other spots of interest in the country. Dodge or Ford cars are available for hire. Possibly the best method is to hire one for so many days. Cost between 15s. to 20s. per passenger per day. A visit to Jericho (thirty miles) and the Jordan will take a day, and should, if possible, be done as the road is very interesting. Bethany, with the house of Lazarus, can be seen *en route.*

About halfway is the inn of the Good Samaritan, with the ruins of a Crusader castle on the hill above it. It gives one a good idea of the Eastern inn.

The driver should be told to go down by the Roman road, which, though very steep, is quite possible. On the left of the road is a very deep gorge with caves in the rock which in earlier days were inhabited by hermits and anchorites.

The glories of the City of Palm Trees have departed, and Jericho is now but a dirty little Eastern village. Large mounds of mud represent the Jerichos of Joshua and Herod. A fine spring, the Tel-es-Sultan, arises just above the village.

The road from Jericho to Es-Salt and Amman runs down to the Jordan, crossing by the Allenby Bridge. The site of our Lord's baptism will be pointed out, also the Mount of Temptation.

On the way back, by the modern road, a digression should be made to visit the Dead Sea. The track is rough, but quite possible for the ubiquitous Ford. Hebron, twenty-five miles from Jerusalem, over a good road, is very interesting. The Cave of Machpelah, with the tombs of Abraham and Sarah, can be seen, and there is also a very ancient and particularly holy mosque. The town is quaint and interesting, with a flourishing pottery factory.

The Pools of Solomon should be visited on the way. Efforts are now being made to make them watertight with the idea of improving the water supply of Jerusalem.

If time permits the tourist should now visit the northern part of the country, travelling by car through Nablus (the ancient Shechem), Jenin, and Nazareth to Tiberias, see the Sea of Galilee, and visit Capernaum,

returning via Nazareth to Haifa where he will strike the railway, and so back to Port Said. Hotels can be found at Nazareth and Tiberias. The distance from Jerusalem to Tiberias is just over 100 miles, and with an early start can be done in a day.

Nablus, the most fanatical town in Palestine, in which no Jew is allowed to reside, is noteworthy for its rapidly diminishing Samaritan inhabitants. Their ancient roll of the Law can be seen. Mounts Ebal and Gerizim, from which the Mosaic Law was given out, overshadow the town.

Jacob's Well is just outside the town with a partially finished Greek church above it. After leaving Nablus, about five miles on the road to Jenin can be seen the ruins of Herod's Samaria.

There is little to be seen in Nazareth save Mary's Well, certainly authentic, the Church of the Annunciation, and the traditional site of Joseph's house. The road to Tiberias runs through Cana in Galilee, where the water was turned into wine, now a poor little village, and on the left just above Tiberias are two small hills, the Horns of Hattim, where the Crusaders were finally and disastrously defeated by Saladin.

Two miles above Tiberias the road drops very steeply, and one prays that the hired car has good brakes, but the view is magnificent. The blue lake is about 1,000 feet below you, with the town of Tiberias looking toy-like at its foot, while Mount Hermon, covered with snow, stands out against the blue sky forty miles away on your left.

The old walls of Tiberias are still standing, with the remains of the Castle of Raymond of Tiberias. There is nothing much to be seen in the town, though Herod's baths, two miles away, are worth visiting. Capernaum, five miles by lake, should be visited, as there the ruins of the synagogue in which Our Lord taught are in very good condition. The trip by boat on the lake is very pleasant, with the slopes of Gadara, famous for the herd of swine story, on one's right, and the village of Magdala, home of Mary Magdalene, on the left.

On returning to Tiberias, the visitor takes his car through Nazareth to Haifa, and there parts with it.

Haifa, with its monastery of Mount Carmel, its cave of Elijah, and its view over the Bay of Acre, deserves a mention. The view at sunset over the Bay from the slopes of Mount Carmel is superb.

The mail for Port Said leaves Haifa about 5 a.m., but one can dine and sleep on the train. The hotels in the town are poor.

In conclusion anyone with ten days' leave to spend from Egypt should not fail to visit Palestine. The climate at the season mentioned is splendid, and the scenery and flowers are magnificent. If a party is made up the cost will not be heavy. If the trip is made at the season suggested, tweeds or heavy flannels should be taken. Most of the travelling will be done at an altitude of 1,000-1,500 feet, and it is uncommonly cold at nights.

Lecture.

A LECTURE TO REGIMENTAL OFFICERS ON VENEREAL DISEASE.

By Lieutenant-Colonel D. O. HYDE, C.B.E., D.S.O.
Royal Army Medical Corps.

The difference in intelligence between civilized man and the lower animals is so great that it is not easy to institute any comparison; in addition man possesses a moral sense, which, if present at all in animals, is only rudimentary. With this superiority it is a remarkable consideration that mankind suffers, and suffers severely, from venereal disease, a class of malady from which the lower animal world appears to be practically exempt.

A malady called dourine, which is sexually transmissible among horses, has been described; and among rabbits there has been observed a urethritis, or inflammation of the genital tract, which may be comparable to gonorrhœa; but, when Metchnikoff tried to inoculate animals with syphilis, he was unable to produce any malady comparable to that disease in man. In one of the anthropoid apes he was able to produce a sore, something approaching a syphilitic sore, but the malady soon died down.

Whatever disparagement we may cast on the morals of apes or monkeys they are in this respect, if not superior, at least more fortunate than man.

Prostitution and venereal disease are matters over which moralists, statesmen and philosophers have shaken their heads.

It is not easy to lay down a rule of conduct which will conform to the teachings of morality, and yet appeal to our intelligence as being within the bounds of human achievement. Even if we are tempted to abandon the accepted principles of morality there is yet no clear way out of the morass.

We know that English Law has refused to give its sanction to any organized system of controlled prostitution; but those who may believe in the efficacy of such a system may be surprised to learn that on the Continent, where such a system has been adopted and, so far as possible carefully carried out, it has not yielded the satisfactory results that were anticipated. And when we carefully consider the nature of these diseases, we have to realize that a system, which in theory seems to be simple, breaks down in a hundred places when put to the test of actual practice, and the actual conditions of human life.

It is only within the last few years that the general public has become aware of the widespread distribution of venereal disease; and the conse-

quences. As the result of this knowledge there has been a profound alteration in public opinion.

I remember, some twenty years ago, making up some of Metchnikoff's ointment; a preparation fundamentally the same as is used in the preventive outfits which are to be found in every barrack to-day. I issued this ointment to the battalion in India of which I was in medical charge, and instructed the men in its use; but I am sure that if my action had become publicly known it would have been repudiated by higher authority; and I must confess that I myself at the time had very grave doubts as to its morality. Since then we have had the Royal Commission on Venereal Disease, and the issue of preventive outfits is not only practised, but is officially authorized. Nevertheless, in spite of the alteration of public opinion, the subject of these preventive measures is still a battle ground of conflicting opinions. We are told that it is a recognition of immorality, a pandering to vice, and that by reducing the risks of infection we make easy the road to debauchery. In view of this opinion it will be as well to lay before you some of the evidence which was given before the Royal Commission, and other facts bearing on these diseases, and you can form an opinion for yourselves.

It was stated by one of the witnesses before the Royal Commission that there are about 850,000 fresh cases of venereal disease in the British Islands every year.

At the London Hospital a special investigation was made among men and women attending the hospital for complaints other than syphilis; the result of the investigation of the blood reaction of these people showed that ten per cent of the men and five per cent of the women were infected with syphilis.

The late Sir William Osler, Regius Professor of Medicine at Oxford University, placed syphilis third or fourth in the list of killing diseases; and it is now well recognized that syphilis is the cause of those terrible maladies of the nervous system, locomotor ataxy and general paralysis of the insane.

In a series of investigations made in 150 families where syphilis existed, it was found that of 1,001 pregnancies there were 172 miscarriages or still-births, 229 deaths in infancy, and of 600 children who survived and lived 390 were diseased. Some years ago a Dr. Tarnowsky gave the record of three families. It is only fair to say that his observations were made at a time when the systematic treatment of syphilis was not fully appreciated. Of these three families the fathers contracted syphilis six, five and four years, respectively, before marriage. All the men appeared to be cured when they married, and all the children were born healthy, that is to say, they showed no signs of syphilis.

In these three families there was a total of twenty-two children. Of all of these, one alone grew up to healthy maturity. Of the remainder, 5 were prematurely born, 3 died of inflammation of the membrane of the brain

before attaining their second year, 2 were imbecile, 2 were idiotic, 1 had numerous signs of degeneration, 1 was weak in intellect, 1 actually insane, 2 were hysterical, 1 was epileptic, 1 was a deaf mute, and 2 had water on the brain.

At the time these statistics were taken 13 were still living, but 8 were incapable of earning their living, and 5 were sickly and nervous.

All these families were of the respectable commercial class, none of the children were exposed to the hardships which, in the case of peasants and artisans, may cause disease falsely attributable to syphilis.

It has been estimated that over fifty per cent of blind children owe their blindness to the venereal infection of their parents. In many of these cases the disease has been conveyed to the innocent mother by the father, whose infection was contracted before his marriage and who believed that he had recovered.

It is perhaps some 4,000 years since Moses was inspired to tell the people that the sins of the fathers were visited upon the children; and millions of people are familiar with the words without realizing their appalling truth.

If this method of prevention has any efficacy (as it undoubtedly has) in checking venereal infection, are we, in the face of so much human misery, to abandon it merely because it is repugnant to our higher sense of morality?

It is encouraging to turn from this method, upon which opinion is so divided, to the consideration of other methods, with regard to which opinion is unanimous; I refer to the efforts made to improve the amenities of the soldiers' life by added comfort in barracks and the facilities for healthy sport and recreation.

It is very encouraging to know that these methods have met with a very definite measure of success. The following figures give the incidence of venereal disease in the United Kingdom, in Aldershot, and in London barracks during the year 1885, and these are contrasted with the figures for the same places in 1913.

Year	United Kingdom	Aldershot	London
1885	275 per 1,000	321 per 1,000	339 per 1,000
1913	50 ,,	29 ,,	95 ,,

Prior to 1913 very little indeed had been done in the way of preventive measures, or, indeed, in the education of the soldier in the matter of venereal disease; we may, therefore, reasonably attribute the improvement as due, in a large measure, to the added amenities of the soldiers' life.

The figures for Aldershot are particularly remarkable in the improvement that is shown. As a small boy I can remember Aldershot Camp in the early eighties; and I can remember being a young medical officer in charge of a venereal ward at Aldershot in 1900. There is a great contrast between the conditions of the Aldershot of to-day, and the conditions prevailing forty or even twenty years ago. It may be said of Aldershot

that the attractions of the barracks are superior to the attractions of the streets.

In London the attractions of the streets and their temptations have not been so easy to overcome; and we see that the venereal rate, though vastly improved since 1885, still compares very unfavourably with Aldershot, being 95 per 1,000 as against Aldershot's 29. The average soldier is not a vicious man. If he has plenty of hard work and vigorous and healthy recreation he will not go out of his way to look for trouble; if he is well fed and not sufficiently employed he will get into trouble just the same as any other class of the community.

Perhaps enough has been said as it were for the case for the prosecution, and it is time to say something in the defence of human nature.

It has been regarded as one of the great disharmonies of nature that man should develop a sexual appetite long before he is fitted to take upon himself the responsibilities of parenthood. There is no need to discuss the physical evils arising from the marriage of the immature, or the economic evils resulting from the marriages which civilization has stamped with the epithets early and improvident. Social law does not recognize any outlet for sexual desire except in marriage; and man finding himself in a desperate predicament had recourse to the desperate remedies of illicit union and prostitution; and in a later and more sophisticated age to the sad compromise of a childless marriage. The conditions of life of sailors and soldiers necessarily prevent the marriage of any but a small minority. In time of war the uncertainty of their lives has always rendered them prone to seize what pleasure they could, and not to think too much of what to-morrow had in store for them. We have to remember, that although, as members of a highly complex community, natural appetite must be controlled and restrained if men are to rise above the level of brutes, yet nevertheless it is on occasion just as natural for a man to desire a woman, as it is natural to feel hunger and thirst.

It is recorded of Sophocles, the great writer of Greek tragedy, that at the end of his life he rejoiced at his release from the thraldom of passion; his words are recorded by Plato: "Most gladly have I escaped from that, and I feel as if I had escaped from a mad and furious master." They are strange words to come from one of the most remarkable men of a remarkable period.

Nature has not left the continuance of the species to any mere ethical or philosophical regard of man for the desirability of its perpetuation. She has secured it by a passion of an intensity that on occasions it can subordinate to itself even the primary instinct of self-preservation. It may be interesting for a few moments to see how different ages and races under varying conditions of civilization have acted under the influence of this force.

Those of you who have been in India will be familiar with the lingam or sexual emblem carved in the rock temples, and may have seen its

representation in brass offered for sale by hawkers. It corresponds to the phallic emblem of the later pagan world; and it is recognized that the worship of the procreative power was one of the earliest forms of religion. The primitive idea had no doubt the perception of the supernal power, which gave and maintained the gift of life through an endless vista of generations; but whatever may have been the original conception of this idea, it does not take much knowledge of human nature to realize that the rites of such a worship rapidly degenerated into licentious depravity.

It has been truly said that there are few forms of abomination that the mind of man has conceived that he has not practised under the cloak of religion. Such sensual forms of worship existed at Babylon, at Bubastis in Egypt, and at Lesbos and at Tenedos in the Greek Islands. A little north of the Dardanelles, on the Asiatic side, the Ordnance map marks the ruins of Priapus. From this centre the worship of the deity of that name spread through Greece and into Italy. The creation of this deity would appear to be a very triumph of human depravity. It was not enough that there should be a worship of Venus and a worship of Bacchus, it was necessary to call into being another deity.

The legend goes that Bacchus made a journey to India to introduce the joys of fermented liquor; on his return he encountered Venus, and as the result of his drunken embraces Venus gave birth to Priapus, and a new god was given to the world to be honoured with a ritual of indescribable obscenity.

At the southern entrance of the Dardanelles, on the Asiatic side, are the ruins of Troy. During the recent stay of the British troops at Chanak I was able to visit Troy, and many of us read translations and other versions of the Homeric legends. From these it may be gathered that virtue and the restraint of their passions were enforced upon women, but that no similar restrictions were placed upon men, save the need of the avoidance of adulterous relations with the wives of others; and lest we should be tempted to feel superior to these morals of the dawn of history let us remember that until very recently this was the precise attitude of our English law of divorce.

The story of the judgment of Paris is an allegory of the opportunity of youth. Had he given the golden apple to Juno she would have made him a leader of men; if to Minerva, she would have given him wisdom to guide their councils; but he gave the apple to Venus: she gave him his reward. He gained the love of Helen, the wife of Menelaus, and, regardless of moral law or the outrage to the honour of the King, who was his host, he carried her away to Troy. To the sin of Paris Homer assigns the cause of the Trojan war, and the scene on the mountains of Ida, where Paris gave the apple to Venus, is the opening of the tragic drama which culminates in the destruction of the Trojan city.

In the story of Penelope, wife of Ulysses, we have one of the most wonderful accounts ever written of the faithful wife.

The turning of the followers of Ulysses into swine by the enchantress

Circe has pointed the moral for many an indictment of the evils of gross indulgence; but if we consider the relations of Ulysses himself with Circe we have to realize that the hero doubtless enjoyed the society of the beautiful enchantress, and we must remember the Greek standard which did not enjoin abstinence, but moderation in all things.

If we leave the legends, and turn to the actual history of ancient Greece, in its most brilliant epoch, it is interesting to observe the position occupied by women.

There were three classes. The Greek wife, whose sphere was the house and the home, and who was esteemed as the mother of children, but who apparently, at least in the upper classes of society, did not share in the life of her husband apart from the intimacy of the home. There were the pornæ who held the place of the common prostitute of to-day, and the very remarkable class of the hetæræ or courtesans. The houses of these ladies were the resort of the most brilliant men of the time. They had an influence on the art, the intellect, and even the political aspirations of the country.

Even the philosopher Socrates, the wisest of the Greeks, did not disdain their society. The beautiful Aspasia was the adviser of Pericles.

Praxiteles, one of the greatest sculptors the world has ever produced, made himself famous by his statues of Phryne, which when executed were placed in the temples. There is an interesting story told of this lady. Being brought before a tribunal of judges to answer for her conduct, her advocate refrained from any address in her defence, but secured her instant acquittal by unveiling in the presence of the judges the matchless perfection of her form.

In marked contrast to the laxity of morals and the tolerance of depravity displayed by Athens in this brilliant age, we have the high moral standard of the early days of Rome, a standard which shows ideals of the purity of life which must be regarded as exalted, even in the present day. At the head of the religious system were two supreme sacerdotal orders; the Vestal Virgins, devoted to a life of purity, any violation of whom was guarded by the most terrific penalties; and the Flamens, who represented marriage in its strictest and holiest form. The Flamen was of necessity married, and his marriage was celebrated with the most solemn rites. Such marriage could be dissolved only by death. If his wife died the Flamen of necessity relinquished his office.

It is said that for 520 years there was no such thing as divorce in Rome. The name of Roman matron was a name of honour; and a Roman writer defined marriage as a lifelong fellowship of all divine and human rights.

In terrible contrast to this we have the almost unbelievable licentiousness of Rome under the Emperors.

I personally abandoned Latin very soon after entering College and have never read Suetonius or the Satires of Juvenal, which are not commonly

put into the hands of the young, but which give a picture of the time in which the writers lived.

History records that the Emperor Tiberius invoked the majesty of Roman Law to forbid any lady of a patrician house placing her name on the roll of the prostitutes of the city.

The following passage is taken from a speech of the great advocate Cicero, which he made in defence of Caelius, a dissolute client. "If there is anyone who thinks that young men should be altogether restrained from the love of courtesans (*meretriciis amoribus*) he is, indeed, very severe. I am not prepared to deny his position, but he differs not only from the licence of our age but also from the customs and allowauces of our ancestors. When indeed was this not done? When was it blamed? When was it not allowed?"

In that age the facilities for divorce surpassed even the wildest ideas of present day America.

It is reported of one gentleman, Paulus Æmilianus by name, that he repudiated his wife without even assigning a reason; when questioned on this he is credited with this reply: "My shoes are new and well made, but no one knows where they pinch me."

One writer records the existence in Rome of a woman who was married to her twenty-third husband, she being his twenty-first wife.

It is only by a knowledge of this frantic depravity of the Roman world that we can understand the attitude towards marriage of the early Christian Church.

Marriage was regarded as a state inferior to that of celibacy. That a man should abandon his wife, or a woman abandon her husband, to lead a life of ascetic purity, was a thing to be applauded; and we read of men who refused to see their mothers, regarding it as a contamination to look upon the face of a woman. The reflection of this attitude is to be found even in our own marriage service of to-day. After much that is beautiful about marriage we reach lines that convey the impression that marriage is to be regarded as a refuge for the incontinent.

I think it is St. Paul who says that it is "better to marry than to burn," a sentence which seems to imply the belief that marriage was a thing to be avoided if possible.

A discussion of the very vexed question of a celibate clergy is better left alone. It was a very thorny question, not only in the early Church, but in a later age. That the practice of some of the religious houses fell very far from precept is unfortunately only too certain, and rests upon the evidence, not of the enemies of the Church, but of religious writers who deplored the existence of the evil.

If we leave the history of man to inquire into the life history of the lower animals we find one principle which is supreme, and to which the life of the individual is subservient, that is the security of the species.

Among bees the workers are asexual and maintain the males who do

not work. At the time of the flight of the queen bee she is followed by the drones, and it must be assumed that it is the most powerful in flight and the most vigorous of these which secures the fertilization of the queen. Once assured of this the worker bees mercilessly drive out the drones to perish. Hundreds of these creatures were created so that the most vigorous might transmit his qualities to the next generation, that purpose being fulfilled all are remorselessly swept away.

The stag maintains his mastery only so long as he is strong enough and fierce enough to drive away other males. When he begins to fail he must yield to another. I once saw two stags fighting, the crash and rattle of their horns as they came together was tremendous. They were too far away for me to see what damage they inflicted upon each other, but when it was obvious that they were both becoming exhausted one broke away and left the other master of the field and the does which stood by and watched the combat. It is by these fierce methods that nature secures the fitness of the next generation.

This was the principle which lay behind the "droit de seigneur" which gave the chief the right (should he wish to exercise it) to have the first access to the bride of any of his serfs.

It is the principle which is invoked in the extraordinary tenets with regard to women with which Bolshevistic Russia has been credited.

As far as man is concerned there is only half the truth in this principle, and as you are aware half truths may be very misleading. Marriage is an institution which is not based solely on the development in man of a higher moral sense. It is also based on a very important fact in the physical development of man. The young human animal takes a very long time to reach maturity; the higher the degree of civilization the longer the period before the human animal can face the world alone without the support, care and the education provided by the parents; even twenty years does not see the end of the responsibility of the parents.

The common house-fly wastes no time on the preliminaries of courtship, having fertilized the female he is without regard for her future, and she, having laid her eggs upon a dung-heap, is absolved of all further responsibility. If for the dung-heap we substitute the State, we have a picture of the ideals of Bolshevism. Civilization demands of man control, restraint, tenacity of purpose, and a subordination of his primary instincts to the general good of his family and his country; and, if we could but believe in the realization of the dreams of the League of Nations, there may be a day when the interests of the individual, of the family, and of the country, will be recognized by all as things to be subordinated to the interests of humanity at large.

For the present we may be content to believe that the progress of a nation is dependent on the realization by its men and women of their responsibility to bring up their children, and train them to take their places in the world; and it is not too much to say that this is alone to be achieved

by a very clear and definite regard for the sanctity and permanence of marriage.

It is one of the penalties of man to be able to conceive ideals which are difficult to attain; and we must admit the humanity of the pagan philosopher, who, while he taught his pupils that their lives before marriage should be free of any act of incontinence, nevertheless warned them that they should not be too hasty or censorious in their judgment on those who did not achieve such a standard.

Current Literature—Pathology.

Contribution to the Knowledge of Inapparent Infections. (Examples taken from the Experimental Study of Exanthematic Typhus.) By M. Charles Nicolle. (*Comptes Rendus de l'Académie des Sciences*, clxxix, 7. August 18, 1924, p. 375.) Translated in the Medical Intelligence Department, Ministry of Health.—Exanthematic typhus in adult human beings is characterized by serious symptoms. In the child these symptoms are less marked; they hardly exist at all in the monkey, and are entirely wanting in the guinea-pig. In all three kinds, however, the thermometer brings to light a fever of a particular type. These are well authenticated statements. The result is that, thanks to the thermometer, the maintenance of the disease can be recognized in the case of the guinea-pig.

Since 1911, after pointing out these facts, I noticed that some of the guinea-pigs which were inoculated in the same manner as others did not show the slightest rise of temperature, and yet their blood was virulent during the fever period of similar guinea-pigs. What is exceptional in the case of the guinea-pig is the rule in the case of the rat. Ch. Lebailly and I, in 1919, gave the name of *inapparent infections* to this type of acute septicæmic infection, which is impossible to recognize except by inoculation.

Procedure.—Let us take the rat as an example. The *inapparent* typhus of this animal is shown by two observations: (1) the absence of the thermic reaction; (2) the infectious condition of the subject. A guinea-pig inoculated at the same time as a rat will trace in its fever curve virtually the same curve as the rat. We take some of the virus of a rat having an *inapparent* infection on the second or third day of the fever of the guinea-pig. Another guinea-pig inoculated with this virus will bear witness by its fever to the infection of the rat. The complexity, but also the extreme clearness, of these experiments, in which only a part of the cases showed apparent symptoms, is easily imagined.

Facts.—The following fresh facts were observed:—

(1) Besides the rat (white or grey), the white mouse and a species of jerboa (*Meriones shawi*) contract typhus under the form of *inapparent* infection.

(2) Typhus is transmissible through a series under the *inapparent form* in the case of rodents (through as many as four passages in the jerboa and five in the rat).

(3) The immunity conferred on the guinea-pig by an attack of experimental typhus of the standard type (febrile) is not absolute. Three guinea-pigs who had had a typical fever a year before were reinoculated; none of them showed signs of fever, but the brains of two of them inoculated into fresh guinea-pigs gave them febrile typhus.

(4) The immunity from *apparent* infection conferred on the guinea-pig by a previous *inapparent* infection is uncertain, and does not last long. It has been found possible to reinfect guinea-pigs under the form of a typical infection (febrile) a few months, and even a few weeks, after an *inapparent* illness.

(5) A first *inapparent* infection protects, for a short time at any rate, the rat, the mouse and the jerboa against an *inapparent* re-infection.

(6) The serum of rats cured of *inapparent* typhus has not so far shown any definite preventive properties against the *inapparent* reinfection of the rat.

Conclusions.—These facts appear to have a bearing which in certain points goes beyond what is already known of typhus. They teach:—

(1) That the absence of symptoms in an inoculated animal does not necessarily prove a naturally refractory condition, or an acquired immunity. From this double point of view certain negative conclusions which have been drawn from the experimental study of typhus will require revision, so that these experiments should be repeated, taking into account the possibility of *inapparent* infections. I will now describe an experiment I made in 1918 with Lebailly, which I did not publish before on account of its peculiar character, but which can now be clearly explained. A guinea-pig, having received filtered blood without showing fever, transmitted the febrile typhus through passage to two other guinea-pigs; exanthematic virus is, therefore, filtrable, at least sometimes, and in a small quantity, because filtered blood gives an *inapparent* infection to the guinea-pig.

(2) No progress can be made with the study of the human disease because no other species reacts to the inoculation of the virus. We may, however, hope that contrary to appearances, some species are susceptible to it without showing any clinical symptoms thereof, and that by some ingenious, roundabout way, experimental study of the disease will become possible.

(3) It is quite possible that some diseases exist among the susceptible species who do not give evidence of them, but who are able to transmit them.

(4) It is logical to suppose that in the susceptible species individuals which have had attacks long ago, and are considered refractory, can take the disease again under the *inapparent* form and transmit it. We have found similar facts in the case of measles.

The subject of *inapparent* infections has only so far been touched upon, and gives promise of very useful application.

Remark.—We must repeat, in order to avoid some confusion which has occurred, that the new term (and the fact that it signifies) *inapparent infection*, has nothing whatever to do with the old term indicating a commonplace fact, *latent infection.*

Latent infection is a subacute or chronic condition, in which the carrier retains for a longer or shorter time, without suffering from it, the germ of a disease which he may have suffered from previously, and which may or may not be susceptible of becoming virulent again for the carrier himself, or of being transmitted to others. *Inapparent* infection is an acute disease, a septicæmia which has its incubation, its evolution and its cure and which leaves behind a more or less durable immunity.

The Diagnosis of Kala-azar by Examination of Thick Blood Films. By R. Knowles, Major, I.M.S., B.M., and Das Gupta, I.M.P. (Temporary Assistant Surgeon) (*Indian Medical Gazette*, vol. lix. No. 9).—The authors, after considerable experiment, elaborated the following technique of preparation and staining of thick blood-smears in order to examine for Leishmania parasites. It is a modification of a technique published by Szilard.

Technique.—In all thick blood film work, the most meticulous attention must be paid to details; nothing spoils a thick film for examination more than the presence of deposit of stain, dirt or bacteria. The glass slides used for the films must be perfectly clean and polished, and should be freed from grease by flaming.

(1) The thick film should be prepared by the method of James (1920, p. 172), with full aseptic technique. Four large drops of blood are placed at the corners of a small square, ½ inch by ½ inch near the centre of the slide. With a round needle or glass rod they are then pooled so that the blood covers the ½ inch square thickly and evenly; "puddling" must be avoided.

(2) The slides are now laid flat on the table, are covered with a Petri dish and are allowed to dry completely. This is the most important point of the whole process. A thick film may appear to be dry in half an hour, but the leucocytes have not yet emigrated to and become adherent to the slide. At least two hours at room temperature, or an hour in the 37° C., incubator, is required; otherwise the film gets washed away during subsequent manipulations.

(3) Lay the perfectly dry thick film—surface upwards—flat on a staining rack. Flood the slide very gently with the following mixed solution:—

Glacial acetic acid; 2·5 per cent in distilled water four parts.

Tartaric acid crystalline; two per cent in distilled water one part.

This solution dehæmoglobinizes the film, and the process should be watched. An ordinary thick film will be completely dehæmoglobinized

in five to ten minutes, but films with thicker patches may require a little longer.

(4) As soon as dehæmoglobinization is complete, drain off the fluid by tilting the slide. Next flood the slide with methyl alcohol. Allow to remain on for one minute. The film is now fixed.

(5) Drain off the methyl alcohol and wash the film very thoroughly in distilled water. Every trace of acid must be removed from the film, or the subsequent staining will be unsatisfactory.

(6) Stain the film with Giemsa's stain, one drop to one cubic centimetre of distilled water. Do not blot the film, but allow it to dry in air, placing the slide tilted against any vertical surface, with the film side downwards to protect it from dust.

(7) Examine with the $\frac{1}{12}$-inch oil immersion lens and a fairly high, e.g., No. 6 ocular. The leucocytes are seen to be evenly scattered, field by field, over the $\frac{1}{2}$ inch square, and can be rapidly examined for *Leishmania donovani*. As contrasted with control thick films from healthy blood, the leucopenia of kala-azar at once becomes most strikingly apparent.

A series of cases was examined by this method, with control observations. The conclusion is drawn that the method is much superior to the thin film method. The parasites are well stained and show up clearly when free or in large hyaline mononuclear leucocytes. They are not so obvious when phagocytosed by polymorphs. The method is not, however, so reliable as culture of the peripheral blood.

Malaria parasites can be recognized in these films, and the carrying out of a differential count is facilitated. J. S. A. B.

On a Herpetomonas found in the Gut of a Sand-fly, Phlebotomus argentipes, fed on Kala-azar Patients. By Major R. Knowles, I.M.S., L. E. Napier and R. O. A. Smith. (*Indian Medical Gazette*, vol. lix, No. 12, December, 1924.)—The paper is a preliminary report of investigations carried out at the Calcutta School of Tropical Medicine, by the authors working ancillary to the Indian Research Fund Association. A study of the epidemiology of kala-azar and a review of the meteorological conditions affecting the incidence of the disease and the development of the sand-fly lead the author to conclude that the three or four months before November would prove to be the most propitious period in which to carry out the experimental investigations which form the subject matter of the paper. In 1922, Major J. A. Sinton, V.C., I.M.S., had pointed out that the known distribution of the sand-fly, *Phlebotomus argentipes*, in India coincides with that of kala-azar, and as regards Calcutta entomological experts showed that sand-flies of the species *P. argentipes* were especially prevalent in the endemic area of that city in August, September and October.

A new technique for the breeding and the feeding of sand-flies in the hot, damp climate of Calcutta during the rainy season was devised and the

feeding experiments were restricted to *P. argentipes* since it was found the *P. minutus*, also a common species, apparently fed only on lizard's (gecko's) blood, and other species of sand-fly observed existed in numbers so scanty as to be considered negligible.

During September, October and November, 1924, eleven consecutive experiments of feeding laboratory-bred female *P. argentipes* upon patients suffering from kala-azar were carried out. In all fifty-six laboratory-bred flies were so fed, and in no less than twenty-five of these herpetomonad forms of *Leishmania donovani* were, on dissection, found infesting the gut of the flies on the third, fourth and fifth days after feeding on the blood of patients who harboured *L. donovani* bodies.

The question of these herpetomonad parasites being developmental forms of *L. donovani* or merely parasites peculiar to the species of sand-fly concerned is considered. Previous investigators had found in the intestine of sand-flies, Crithidia and a Monad—the latter, it is stated, was probably a mistaken interpretation of the spermatozoa of the sand-fly. Mackie also in 1914 found herpetomonas infesting the intestine of *P. minutus* in a heavily infected kala-azar area in Assam, but had been unable to find any corresponding herpetomonad in the gecko.

Moreover, the authors in the course of their research had examined 811 control sand-flies including both *P. minutus* and *P. argentipes* and the only natural infections found were Rickettsia (once), a Bodo (three times) and in one fly a doubtful spirochæta. Mammalian blood was found in *P. argentipes* only. In *P. minutus* only reptilian blood. In none of the 811 control flies examined was anything resembling a natural herpetomonad found. On the other hand the eleven feeding experiments were consecutive and included only one failure.

In addition to examining wild flies and unfed laboratory-bred flies as controls, seven control-feeding experiments were carried out with laboratory-bred flies which were fed on patients not suffering from kala-azar. In forty-six female flies (*P. argentipes*) so used, no protozoa and no herpetomonads were found.

In conclusion the authors state that there is every reason to believe that the herpetomonad found in the intestine of laboratory-bred *P. argentipes* from three to five days after feeding on a kala-azar infected person is the herpetomonad form of *L. donovani*, but they do not intend to lay down any hypothesis as to the mode of transmission of kala-azar on the evidence of this work which is purely preliminary, they record the observed facts in the hope that they will interest and stimulate other experimental workers in the field. A. E. H.

On Diphtheria Toxin and Anatoxin, Flocculating and Immunizing Properties. By Ramon (*Annales de l'Institut Pasteur*, 1924, vol. xxxviii, p. 1).—Toxicity of filtrates of cultures of diphtheria bacillus increases at 37° C. up to the 9th day and then begins to decrease. The antigenic power also increases up to the 9th day, but afterwards remains steady at 37° C.

By adding formalin 3-4 parts per thousand to a highly toxic filtrate and incubating the mixture at 42° C., the latter can be rendered innocuous to a guinea-pig even in doses of 6 c.c. The rate of flocculation reaction of this "anatoxin," as the author calls it, may be slowed, but otherwise it is unaltered and its antigenic power is unaffected.

Anatoxin has proved, in the immunizing of hordes, equal to any sample of ordinary toxin. H. J. B.

Flocculation in a Neutral Mixture of Diphtheria Toxin and Antitoxin. By G. Ramon (*Compt. Rend. Soc. Biol.*, 1922, vol. lxxxvi., p. 661).

Technique of Titration "in vitro" of Anti-diphtheritic Serum. By G. Ramon (*Compt. Rend. Soc. Biol.*, 1922, vol. lxxxvi, p. 711).

Concerning the Titration "in vitro" of Diphtheria Antitoxic Serum of Flocculation Tests. By G. Ramon (*Compt. Rend. Soc. Biol.*, 1922, vol. lxxxvi, p. 813).

The Concentration of Anti-Diphtheria Serum and the Isolation of the Antitoxin. By G. Ramon (*Compt. Rend. Soc. Biol.*, 1923, vol. lxxxviii, p. 167).

The Flocculation and Toxicity of Diphtheria Toxin. By G. Ramon (*Compt. Rend. Soc. Biol.*, 1923, vol. lxxxix, p. 2).

These accounts deal with a flocculation reaction in the standardization of diphtheria antitoxin.

If to a fixed quantity of toxin varying ascending doses of antitoxin are added and carefully mixed, an opalescence will form which gradually changes after some hours to true flocculation. This will occur in one tube before the others. If the contents of each tube are injected into guinea-pigs toxic symptoms or the reverse will appear, according to whether there is an excess of toxin or antitoxin, in all the animals except the one which received the mixture from the tube which showed the flocculation first. This means that in the tube in question, the toxin has been almost exactly neutralized by the antitoxin. Heating at 58-60° C. for half an hour prevents this reaction. On the other hand a toxin may be quite atoxic, but still retain its flocculation power although the reaction may be allowed.

A series of test tubes is arranged and in each tube is placed 20 c.c. of of toxin of unknown strength. To this is added antitoxin containing 250 Ehrlich units per c.c. in doses ranging from 0·2 c.c. to 2 c.c. Now the quantity of antitoxin in the tube first flocculating multiplied by 250 equals the number of units which will neutralize 20 c.c. of toxin. Having standardized the toxin, it is now possible to standardize unknown antitoxin by this method.

Methods of concentration and purification of diphtheria antitoxin are discussed.

45° C. is the optimum temperature for the reaction. The author does his tests as a routine at room temperature. Flocculation may take anything from a quarter of an hour to twelve hours. H. J. B.

Reviews.

TEXTBOOK OF PATHOLOGY. By Robert Muir, M.A., M.D., Sc.D., F.R.S., Professor of Pathology, University of Glasgow, Pathologist to the Western Infirmary, Glasgow. London: Edward Arnold and Co. 1924. Pp. vii and 774. Price 35s. net.

It is with pleasurable anticipation that one interested in pathology reads through a book on this subject by a teacher of the eminence of Professor Robert Muir, and this anticipation is in no small measure fulfilled by the clarity of exposition and the method of presentation of the subjects brought under review.

The volume, as the author indicates in the preface, is intended primarily as a textbook for students, and as such has had to be limited to a reasonable size. In view of the fact that pathology now covers such a diverse and extensive range, it is evident that it requires a mature and well-balanced judgment to make a decision as to the nature of the subjects dealt with in a volume limited to the dimensions of some 756 pages. Professor Muir has, as one would expect, succeeded in this difficult task, and whilst he has presented us with a concise and modern treatise on the more important cellular changes encountered in conditions of disease, he has not neglected to emphasize the relation of these changes to the clinical manifestations resulting from disturbances of function.

The book may be regarded as being composed of two parts, the first seven chapters dealing with the subjects generally classed together as general pathology, and the remainder of the book being devoted to pathology of the special systems.

In the first part of the book the section on immunity is worthy of special note, the subject being expounded with remarkable clearness. The familiar diagrams of Ehrlich's side-chain hypothesis are not included, nor, indeed, is the word side-chain mentioned. The chapter is in fact a critical exposition of what can be regarded as the facts of immunity, without any waste of space elaborating or discussing theories thereanent. This is the keynote of the whole book. Facts are given precedence to theories, especially where the latter, because of our present state of knowledge, are of a dubious nature.

Two chapters are devoted to the systematic classification and description of tumours, but of course further reference to these is made in the description of the various lesions of the special systems. New growths are divided into histiomata or tissue tumours, and cytomata, or cellular tumours, and as these groups in the main correspond to simple and malignant

tumours, the advantage of the classification is obvious, although there are borderline cases which are difficult to relegate to one class or the other. The latest views on the ætiology of tumours are considered, and factors related to the development of malignant tumours are discussed under the headings of "chronic irritation" and "abnormalities of development." As regards the latter the author expresses the view that adenomata in mamma, liver, adrenal, etc., usually arise from displaced cells, as do teratomata. While noting that such displaced cells more readily take on malignant proliferation, Professor Muir points out that the mere fact that such cells *are* displaced is no adequate explanation of the alteration of their habits which takes place when they assume malignant characters. In all malignant tumours there is a particular time when the cells change from tissue cells to tumour or malignant cells, and of the real nature of this change we have no knowledge. This is an all-important hiatus.

In the chapter on diseases of the circulatory system, a notable inclusion is a section on diseases of the conducting system, in which the findings of the polygraph and electrocardiograph, which are explained and illustrated by diagrams, are correlated with the underlying organic changes in the heart and elsewhere.

Under the heading of jaundice, the recent work of Van den Bergh is described, and its relationship to the classification of the different types of jaundice is discussed. Professor Muir considers that our present knowledge is such that any classification can only be regarded as provisional, although the main headings of hepatogenous, divided into obstructive and toxic, and hæmatogenous, probably hold good.

The chapter on the endocrine glands is very valuable in giving views based on much recent work that has not found its way into the majority of general textbooks.

In the sections on parasitology, which occur under the various systems thus affected, a few trifling matters occur which invite criticism. The naming of the parasites is not in some cases in accordance with what are now accepted standards, a matter which may lead to the confusion of a student not versed in the numerous synonyms these creatures enjoy. Another small error lies in ascribing a radia stage to *Schistosoma hæmatobium* in its development in the intermediate host.

Throughout the text there are some 433 illustrations, the majority of them photographs, which are, with one or two exceptions, of high standard of excellence.

These few points on which comment has been made have been selected, not so much because of their importance as to illustrate the completeness of the work. Nothing of importance relating to the diseases of temperate climates has been omitted. The book is permeated by a spirit of profound soundness and common sense, and we feel sure that, both as a student's text-book and as a practititioner's book of reference, it is destined to occupy an exalted position.

THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR. Vol. XI. Surgery, Part II. Washington: 1924. Pp. 827.

This volume includes empyema, maxillofacial surgery, ophthalmology in the United States, ophthalmology in the American Expeditionary Forces, otolaryngology in the United States, and otolaryngology in the American Expeditionary Forces, and has been prepared under the direction of Major-General M. W. Ireland, Surgeon-General of the Army.

The section on empyema has been prepared by Lieutenant-Colonel E. K. Dunham, M.C., and is an amplification of the work started in 1918 by the Empyema Commission, which was in turn an outgrowth of a Pneumonia Commission sent to Texas in February, 1918, to study cases of pneumonia which was causing sixty-five per cent of all cases of death in the United States Army.

This Commission discovered that the *Streptococcus hæmolyticus* was the chief causative agent, giving rise to a form of pneumonia termed interstitial pneumonia. As empyema was found to be an important complication of these streptococcus pneumonias, a second commission was formed to study empyema.

Chapter I contains a survey of the methods adopted for the collection and utilization of data concerning empyema cases, and gives the detail of the questionnaire, circular, and "follow up" letters used.

Chapter II deals with epidemiology and is the study of the data from twenty-three camps. The data from these camps is tabulated, special points being emphasized by graphic charts, prepared with meticulous care and ingenuity. The charts indicate that the incidence of empyema conformed throughout to that of infections of the upper respiratory passages and to the distribution of a strain of streptococcus of varying virulence and, finally, that when the incidence of diseases of the upper respiratory tract reached such proportions that one per cent of the command was sent to hospital for treatment, the presence of strains of bacteria likely to attack the pleura was indicated and empyema almost certain to develop.

Chapter III is concerned with pathology and the routes of extension of the infection to the pleura and to other parts than the pleura are discussed. Post-mortem evidence indicated that the two chief routes of infection are the alveolar and interstitial, the former associated with early signs of pneumonia, the presence of pneumococci, and the latter with early pleural pain and the presence of streptococci.

In Chapter IV the treatment of empyema cavities with antiseptic solutions is dealt with. Dakin's neutral solution of sodium hypochlorite was chiefly used. The difficulties encountered in its application to the cavities, and the best methods for meeting these difficulties are discussed, as are the conclusions arrived at from the study of a large series of cases treated wholly or partly with Dakin's solution. Full details of the Carrel-Dakin technique are given.

Chapter V emphasizes the great assistance given by the Roentgen ray laboratory in the study of these cases. Radiograms and fluoroscopic examinations, both before and after the cavity had been filled with bismuth suspension, provided invaluable information as to the size and position of the cavities, the presence of pockets and pleura-pulmonary fistulæ and the effects of the treatment.

The above features are admirably illustrated by the reproduction of a large number of radiograms.

The symptomatology and physical signs of streptococcus pneumonia and pleuritis are described in Chapter VI.

Clinically there were two distinct types, one in which pneumonia dominated the situation from the onset, whilst in the other the pleura was predominantly involved.

Aspiration was the only positive means of diagnosing effusion, though Roentgen rays were of assistance.

Since 1918 the treatment of empyema occurring in the course of streptococcus pneumonia has been modified to a great extent and a distinction made between it and the treatment of empyema following lobar pneumonia. Great stress is laid on the advisability of postponing surgical drainage of streptococcus empyemata until the broncho-pneumonia is no longer active, as indicated by the return towards normal of the pulse, temperature and respirations, and by the exudate becoming definitely purulent, usually about two weeks after the onset of the pneumonia. During the interval aspiration is relied on, every one to two days if necessary.

The surgical treatment of empyema is described in Chapters VII and VIII. The substitution of aspiration for early surgical drainage caused an immediate drop in the mortality from 40 to 4·3 per cent. It was found that of the acute cases studied by the Commission thirteen per cent recovered after aspiration alone, but in the large majority of cases surgical drainage was necessary later.

To prevent the development of a chronic empyema it was necessary to achieve both sterilization and obliteration of the cavity. Sterilization is a natural process, and nature was best assisted by adequate drainage. As the failure of cavities to obliterate themselves is due to fibrosis of the lung itself and the formation of an inelastic coat of exudate on its surface, it was considered that Dakin's solution, as both an antiseptic and a solvent of exudate, should be an ideal ally to efficient drainage.

Dakin's solution was therefore used by the Commission immediately after the operation for drainage and with excellent results. Even chronic cases with old standing sinuses, when treated with rib resection and thorough opening up of loculi, and followed by irrigation with Dakin's solution, frequently recovered. There remained, however, a number of chronic empyema patients, the residue of the influenza epidemic of 1918 and 1919, in the case of whom the skilful and untiring application of the

above treatment went unrequited. Most of these patients were transferred to the Walter Reed General Hospital, Washington, where the "open" type of operation was put into practice in 1920. An account of the treatment of these cases is given in Chapter VIII.

The chief causes of chronicity were found to be the presence of diverticula and pleuro-bronchial fistulæ. Each case was thoroughly investigated and placed on a high caloric diet. Preliminary irrigation with Dakin's solution was instituted and the outlines of the cavity were accurately localized with bismuth injections and Roentgen rays.

Paravertebral anæsthesia combined with infiltration of the operation area with novocain was used. The operation was performed in steps, and when the systolic blood-pressure fell to ninety millimetres of mercury the operation was discontinued. By the resection of ribs (divided with the periosteum) the cavity was thoroughly exposed, the skin and divided muscle being anchored over the rib stumps to prevent retraction, and the whole exposed area packed and irrigated with Dakin's solution. By successive operations the whole cavity was exposed and the collapsed lung freed from its fibrous covering, if necessary by chemical decortication with alcoholic solution of gentian violet. When the wound was culturally sterile it was closed up, suturing the divided muscles into the residue of the cavity and suturing the skin over all. Clinical notes of forty cases so treated are given. Of this series thirty-seven left hospital with their wounds closed.

The study of this special type of empyema is marvellously complete in clinical, bacteriological and pathological detail. The compilation of the valuable data collected by the Commission and the description of the revolutionary surgical treatment forms a great addition to what was previously known of the disease, and cannot fail to attract those interested in the subject.

The section on maxillofacial surgery was edited by Lieutenant-Colonel Robert H. Ivy, M.C. and Major Joseph D. Eby, D.C.

The principles of treatment adhered to at advanced and base hospitals for gunshot wounds of the face and jaws are described. The necessity for provision of ample drainage, early reduction and fixation of fractured jaw fragments with preservation of all viable bone, is emphasized.

The various splints in common use are described.

Chapter III deals with treatment of the same type of injury at a later date, when the patient had returned to the United States.

The technique, advantages and disadvantages of intermaxillary wiring, and the methods employed for restoring occlusion of the jaws in cases where the mandibular fragments had collapsed, are explained.

The different methods of bone grafting, and the appliances used for overcoming trismus are reviewed and contrasted. Reference is made to Waldron's modification of Esser's operation for using Thiersh grafts to replace lost oral mucous membrane.

Under the heading of plastic operations of the soft tissues of the face,

the conclusions arrived at as to the making of cutaneous flaps, based on the extensive observations of Blair, are given in detail, with illustrations depicting these principles and followed by notes of miscellaneous cases treated with great surgical ingenuity.

An account of the different rhinoplastic methods employed is given with illustrations of a number of cases in different stages of repair.

Section III on "Ophthalmology in the United States," was edited by Brigadier-General George E. de Schweinitz, M.O.R.C. Statistical tables of the numbers of cases of different diseases treated in military stations in the United States are followed by general comments on these diseases. It is interesting to note that trachoma, always a menace in army life, proved far less formidable than had been anticipated.

In Chapter IV is given an analysis of 117 blind cases. Notes on thirteen cases of wounds involving the occipital lobes are published, and the visual defects caused thereby, attention being drawn to certain apparent contradictions noticed in comparing the conclusions arrived at by the observers of these cases with conclusions arrived at by Holmes and Lister. Under blepharoplasty and ocular prosthesis thirty-six cases are reported, with numerous illustrations.

Section IV on "Ophthalmology in the American Expeditionary Forces," was edited by Colonel Alan Greenwood, M.O.R.C. In the introduction is published an extract from the report of the British Ophthalmic Service in France, made by several officers who were sent from the office of the Surgeon-General prior to the arrival of the American troops in France, and the recommendations made, followed by extracts from circulars relating to ophthalmic conditions issued by authority of the Chief Surgeon, American Expeditionary Forces.

Chapter I is concerned with diseases and injuries of the eye and includes a note on intraocular foreign bodies.

Chapter II is devoted to certain special studies, notably the treatment and care of the blind, and the ophthalmic disturbances due to war gases.

The section on "Otolaryngology in the United States" was prepared by Lieutenant-Colonel S. J. Morris, M.C.

In the introduction are shown photographs of departments of the Otolaryngological Service in certain hospitals and illustrations of the forms used for recording the history and examination of patients.

Chapter I deals with examination of recruits.

Purulent otitis media was regarded as an absolute disqualification for military service.

A short review follows of diseases of the nose, pharynx, tonsils, larynx and ears occurring amongst troops in the United States.

Section VI on "Otolaryngology in the American Expeditionary Forces," is edited by Colonel J. F. Mackernon, M.C.

The organization of the Otolaryngological Service is described.

The number of men in the Expeditionary Forces found to be suffering

from chronic otitis media indicates the extreme difficulty of recognizing such cases on enlistment.

A short account of battle injuries of the ear, throat and nose, completes this section. H. C. S.

MANUAL OF SURGERY. By Rose and Carless. Eleventh Edition. London: Baillière, Tindall and Cox. 1924. Pp. xii + 1,600. Price 30s.

"Rose and Carless" needs no introduction to officers of the Corps, and the publication of the eleventh edition (1924) of this standard "Manual of Surgery" is sure to be of interest to those who are engaged in active surgical work, but the memory of "the shattered victims of those four years of frenzied madness" is too fresh to allow any of us to forget that we have surgical obligations, and that the duty of making every attempt to keep abreast of the trend of surgical teaching should not be left entirely to the specialist.

The volume is presented in the same form, and is approximately the same size as the last edition published in 1920, but many chapters have been altered, and brought up to date by well-judged "pruning" and the substitution of recent ideas and methods relative to classifications or the principles involved in diagnosis and treatment. In this respect the chapter headed "Deformities, Orthopædic Surgery," is especially concise and useful, and serves to remind us that many problems in surgery which may at first sight appear to be intimately bound up in questions of "bone union, paralysis (apparently hopeless) of muscle groups and blood supply" can really be solved by concentrating attention rather in the direction of "bone alignment, muscle balance, and nerve supply."

The chapter on "Hæmorrhage" and the appendix on "Military Surgery" (in which Major Everidge, R.A.M.C., has collaborated with the author) will be found to contain nothing new to those officers who have had the advantage of attending the lectures on Military Surgery at the College, but the sections referred to will serve as a useful synopsis of many of the surgery lectures delivered during the course. We are reminded on p. 1,496 of the results of improved methods of treatment and organization in forward areas in the following words: "The difference produced by increasing the number and personnel of the casualty clearing station is apparent from the following figures: At a base hospital in France, in the summer of 1916, five cases out of six required operation, whereas in the summer of 1917 at the same hospital only two out of six wounded men were in need of operation."

Advances in plastic surgery have been great, and in a manual of this kind it would be out of place to expect more than a brief reference to this very special branch of the art of surgery, but those of us who had the advantage of knowing and working with Colonel Simpson Newland, of the Australian Forces, will be pleased to see a short contribution by him under the heading of "Rhinoplasty."

All the small print introductions to chapters or footnotes dealing with such things as regional anatomy, or the technique in using some of the special instruments, will be found most useful. There are excellent chapters on "Amputations" and "Anæsthetics."

Controversial subjects, such as cholecystectomy and cholecystotomy—when to operate in acute appendicitis—to instance only two of them, are dealt with in a tactful and common-sense manner. Individuality is often an attribute, but pig-headedness in regard to matters which are still obviously controversial is a bad fault.

The "printer's devil" has done his work well. There is, however, one misprint on page 78, paragraph 3, line 6. Possibly an etymological pedant might take exception to the term "thermogenic centre" on page 71, and pompously recommend the words "heat regulating centre" as more applicable, but most readers will be far too absorbed in the sense and general style of presentation of the subject to bother about such trifles. Many surgeons would object to being coerced into using "gauze wicks" in the peritoneal cavity, preferring rubber tissue (dam) in such instances.

Finally, there can be no harm in commending a few lines in the author's preface to all: "The surgeon must learn how to give, not only his knowledge and skill, but also his sympathy. . . ." We can all give the latter; to those who feel shaky in the first two attributes one can thoroughly recommend "Rose and Carless" as a very useful stepping-stone, especially in an out-station.

D. C. M.

PRINCIPLE OF EARLY ACTIVE MOVEMENT IN TREATING FRACTURES OF THE UPPER EXTREMITY. By J. W. Dowden. Edinburgh: Oliver and Boyd. 1924. Pp. xvi + 111. Price 16s. net.

This short work demonstrates, chiefly by means of illustrations, the results obtained by applying the principle of early *active* movement in the treatment of fractures of the upper extremity. The author omits reference to operative and other forms of treatment, as he considers that they are only called for in exceptional cases, and the work is addressed primarily to the general practitioner.

A visit to any massage department of a hospital is a demonstration that the treatment of fractures has not progressed as rapidly as other branches of surgery, and there are still many cases suffering from the effects of prolonged immobilization by splints and the lack of early active movements.

There is, unfortunately, still the tendency to rely on splinting, to be combined later with massage and passive movements. A study of this work will show that *active* movements are going to benefit the patient, and that the sooner they are started and persisted in, the better the functional result will be.

This work could be perused by all medical officers with advantage.

G. D. la C.

Correspondence.

THE ÆTIOLOGY OF PHLEBOTOMUS-FEVER.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I have read with great interest the article by Wing-Commander H. E. Whittingham on the above subject, in the March number of the Journal. But perhaps I may be allowed to point out that Whittingham concludes in the negative sense, with regard to the applicability of my view of abnormal hæmetaboly in this particular case, on what, I think, is quite a mistaken ground. After describing experiments undertaken to prove that the infection of the insect is not hereditary, the author says (p. 200): "These results showed . . . (3) that the fever was not due to the *Phlebotomus* injecting into man some altered product of blood-digestion, as has been suggested by Woodcock." Now, in the first place, I have never claimed that the infection in those virus diseases which I think may be due to abnormal hæmetabolic (or cytolytic) enzymes is, necessarily—if, indeed, ever—transmitted hereditarily. Further, as the virus, whether a *Leptospira* or any other agent, was not present at all in the flies bred-out according to the manner of the particular experiment, I confess I fail to see how any deduction at all as to my view can be made therefrom.

On the other hand, Whittingham does not say if *Leptospira* was found, either in the infective bred-out flies which had apparently become infective by feeding on the fæces or dead remains of the parent-females, or in the blood of the volunteers who became infected; it would be most interesting to have been informed with regard to that important point. I take it that these parent-females were known, or considered to be infected, although this might, perhaps, have been definitely stated.

I am, Sir, etc.,
H. M. WOODCOCK.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

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Original Communications.

THE ERADICATION OF HELMINTHIASIS FROM THE EGYPTIAN ARMY.[1]

By MAJOR B. H. H. SPENCE.
Royal Army Medical Corps.

(1) PARASITIC WORM INFESTATION AMONGST EGYPTIAN ARMY RECRUITS.

IN the autumn of 1923 the Sudan Government, not for the first time, raised the question of the admittance to the Sudan of soldiers of the Egyptian Army infested with parasitic worms. Though the Government was undoubtedly justified in demanding that its efforts at Wadi Halfa Quarantine to prevent the introduction and dissemination of parasitic worm diseases should be backed up in every possible way, there was, perhaps, a tendency to attach too much weight to the potential danger from these soldiers, less than 2,000 of whom normally proceed to the Sudan in any given year, especially as the great majority of them are stationed in Khartoum, Halfaia and Omdurman, where their general mode of life and sanitary surroundings preclude the possibility of their disseminating parasitic worm diseases, whilst most of the remainder are stationed in places where these diseases are either already endemic, or else cannot be spread for biological reasons. The occasion seemed ripe, however, for expressing the opinion that there existed more than sufficient grounds for tackling the whole problem from the purely military point of view, as one primarily and deeply concerning the health and efficiency of the army, and which it appeared to be the duty of the medical service to undertake at once and in a comprehensive manner.

It is a matter of common knowledge that widespread infestation of a

[1] A Thesis written and accepted for the M.D. degree of Edinburgh University.

community with parasitic worm disease lowers its standard of health, physique, efficiency and *moral.* Ankylostomiasis and schistosomiasis have always been very prevalent in the Egyptian Army, and, as both diseases are essentially curable, the arguments in favour of their eradication appear to be overwhelming.

The strength of the Egyptian Army is maintained by conscription from a population, the majority of whom are known to suffer from parasitic worm infestation. Every year about 90,000 youths in Egypt reach the age of 19, and become liable to be called up for military service. Recruiting commissions, which tour the provinces, weed out about 80,000 of these. A man may claim exemption on the grounds that he is the bread-winner of a family; that he is the only son of his father; or that he is the eldest son of a divorced mother; or he may buy exemption by the payment of £E20; but the great majority are rejected on sight as medically unfit, a terrible commentary on the prevailing state of health of the masses in Egypt. Should more than 10,000 be available after this preliminary examination the required number are selected by ballot, and sent into Cairo when they reach the age of 21 for final medical examination. Another 6,000 of these obtain exemption for one or other of the reasons stated above, the great majority again because they are medically unfit. Thus about 4,000 are finally taken, that is to say about four per cent of those who were originally available.

The routine method by which sufferers from parasitic worm infestation were supposed to be eliminated at the final medical examination proved to be valueless in practice.

Measures for the detection of cases of urinary schistosomiasis were confined to a naked-eye examination of the urine. Senior medical officers were long victimized by a wily ex-shawish (sergeant) of the Medical Corps, who built up a lucrative "practice" by injecting blood-stained urine into the bladders of conscripts the night before the final medical examination! Detection came, followed by swift retribution, when an unfortunate "patient," seized with an urgent desire to micturate during a cold night, and unwilling to lose the benefit of his investment, tied a cord so tightly round his penis that his bladder burst before dawn and his gangrenous organ had to be amputated shortly after!

For the detection of the less common but much more serious disease, schistosomiasis of the rectum, no test was applied at all.

The only test applied for the detection of ankylostomiasis was a naked-eye estimation of the degree of anæmia present.

An examination of the statistics of the Egyptian Army General Hospital, Cairo, for 1923, clearly demonstrates the inadequacy of the tests applied for schistosomiasis of the urinary bladder and ankylostomiasis, and also brings out the vital necessity for a test for schistosomiasis of the rectum. Thus, during 1923, no less than 14 per cent of the men treated in that hospital were admitted primarily for parasitic worm diseases, whilst, of 253

men found unfit for further service during the same period, 73, or 29 per cent, were invalided for the same cause, the majority for schistosomiasis of the rectum. In addition to this a large proportion of "fit" men are known to suffer constantly from anæmia, debility, palpitation, arrhythmia epigastric discomfort, dysuria, hæmaturia, passage of blood in the stools, and other signs and symptoms of parasitic worm disease, without feeling ill enough to seek hospital treatment.

Now it has long been a matter of common knowledge that the Egyptian fellah, removed from his native country and mode of life, and sent to serve as a soldier in the Sudan, succumbs all too readily to the vicissitudes of service in a climate which, even in perfect health, he is after all little more fitted to withstand than the European soldier. This failing has been commonly attributed in the past to some inherent inexplicable defect in the constitution and character of the Egyptian peasant. The statistics quoted above afford the strongest possible evidence for believing that the undisputed lack of resistance to hardship of the Egyptian soldier, far from being an inherent defect is really an acquired one, due to chronic infestation with parasitic worms. In any case until the part played by parasitic worm disease in undermining the constitutions of Egyptian soldiers has been properly investigated it would be wiser to refrain from imputing to nature what is much more probably due to neglect.

Convinced by a survey of the situation that action was called for, I felt justified, as the officer responsible for the examination of the 1923-24 batch of recruits, in introducing measures for mass diagnosis and treatment of worm diseases at the final medical examination.

(2) Disposal of Arguments against the Need for an Anthelmintic Campaign in the Egyptian Army.

At this time and subsequently numerous arguments were advanced against the necessity for an organized scientific campaign to eradicate parasitic worm infestation from the Egyptian Army. These arguments were calculated to impress the lay mind, and as they seemed likely, if supported, to prevent the introduction of a measure designed solely in the first instance for the improvement of the health of the private soldier, it became necessary to refute them in terms which would admit of no misunderstanding.

It was alleged that parasitic worm diseases had always been dealt with in the Egyptian Army. But there is a fundamental difference between (*a*) waiting until some of the worm-infested individuals in a community have become so ill as to require hospital treatment, or even invaliding, and (*b*) searching out and treating all the worm-infested individuals in a community before any of them have become ill at all. The former method is palliative only; it has had a fair trial in the Egyptian Army for many years, in which it has proved a failure, as it has in every other worm-infested community in the world. The latter

method, that of the anthelmintic campaign, is radical, and has proved successful wherever it has been applied.

It was alleged that the tests already described for these diseases had given satisfactory results in the past; but this assertion is not supported by the official statistics of the Egyptian Army General Hospital, Cairo, for 1923.

It was alleged that many men get rid of their infestation by natural means in the course of five years service. But the whole weight of army statistical evidence is against such an assumption. The real truth is that far from army service enabling infested men to throw off their infestation it is directly responsible for large numbers of men who appear on superficial inspection to be perfectly fit on enlistment, breaking down all too readily under the vicissitudes of service in a bad climate. It is of course understandable that a small proportion of ankylostomes and a smaller proportion of schistosomes may and probably do die off in the course of five years service, but in view of the span of life of the worms, the number of men who could become cured in this way must be so extremely small as to be negligible. In any case as long as large numbers of men are being treated in hospital and invalided the difference, if any, in the percentage of infestation amongst recruits and serving soldiers must be ascribed to treatment and invaliding in default of direct scientific evidence in favour of the natural cure theory. Moreover, even if natural cure were proved to be a factor in the case, it appears undesirable to wait five years for nature to accomplish what science can do in as many hours or weeks. Finally it was alleged that the whole question was one for the Public Health Department of Egypt, rather than for the Army, a counsel of perfection which revealed a lack of appreciation of the gigantic nature of the problem before that Department, of the number of years likely to be occupied in solving it, and of the huge expenditure certain to be involved in its solution. The problem of the Army is, in comparison with that of the country as a whole, a relatively urgent one, capable of immediate and complete solution at a cost which would be infinitesimal compared with the benefits that would certainly ensue. Furthermore, as the Medical Corps has entire control of every phase of medical and sanitary work concerning the Army, it appears to be absolutely unjustifiable to dismiss this particular problem by laying the onus of its solution on the Public Health Department, especially as it is quite obvious that this procedure cannot possibly result in any improvement for years to come.

One might reasonably have anticipated that objections would be lodged against the scheme on the grounds of military expediency, owing to the fact that treatment, especially for schistosomiasis, would involve detention of recruits with consequent delay in their training. This fear proved groundless. The Inspector General of Egyptian Army troops in Egypt, El Lewa C. W. Spinks Pasha, D.S.O., O.B.E., considering that any attempt to improve the existing state of affairs, even if it should end in failure, was worthy of a trial, and recognizing that the slight temporary military

inconvenience involved was negligible, compared with the ultimate benefits likely to accrue, helped to further the scheme in every possible way. This attitude was assumed by all the Egyptian officers commanding units serving in Egypt, who were only too well aware of the part played by parasitic worm diseases in sapping the vitality and efficiency of their men.

(3) Organization of Routine Measures for Mass Diagnosis of Ankylostomiasis amongst Egyptian Army Recruits.

The Adjutant-General of the Egyptian Army, El Lewa H. J. Huddleston Pasha, C.M.G., D.S.O., M.C., having given provisional approval to the scheme, I approached the Public Health Department. Interviews with Dr. Charles Todd, Director of the Laboratories, and with Dr. Mahommed Khalil, Lecturer in Helminthology at the School of Medicine, Cairo, were followed by visits to the Anthelmintic Annexes at Kasr el Aini Hospital and Qualioub, at both of which places one could not fail to be impressed by the scientific thoroughness with which hundreds of cases of ankylostomiasis and schistosomiasis were being diagnosed and treated every day.

The necessary apparatus was purchased and a small supply of carbon tetrachloride borrowed from the Public Health Department.

These preparations having been made, it was decided, as a preliminary experiment, to get to work on a batch of about 300 recruits for the Police School, Abbassia. These are conscripted by the Recruiting Department at the same time and under exactly the same conditions as recruits for the Army. But here an unexpected check occurred owing to the Commandant of the Police School objecting to experiments being carried out on his men. As he was not under military discipline it became necessary to apply for support to the Ministry of the Interior. Unfortunately, the Commandant had preceded me by two hours, and left again armed with covering authority for his attitude. I asked for and obtained an interview with Abd el Razik Pasha, the Under Secretary of State for the Interior in the Yehia Ministry, a courtly and intelligent Egyptian gentleman, whom I bombarded with the statistics and photographs collected during investigations carried out at Wadi Halfa quarantine. Whether his conversion was the result of conviction or the outcome of a desire for peace, is neither here nor there. At any rate I left at the end of half an hour armed with a counter order which completely smoothed away all further difficulties.

The recruits for the Police School were sent by the Recruiting Department to the Egyptian Army Hospital at the rate of seventy a day. From this number about fifty were selected who had every appearance of perfect health. They were then sent back to the Recruiting Department, where a few would make good their claims to exemption on grounds not connected with their health. The balance, perhaps forty-five, after being detailed to their units, were returned to the hospital, where they were passed through the newly-organized anthelmintic annexe.

On entering the annexe, each man was given a serial number for the day which, together with his name, unit and province, was entered on a form especially printed for the purpose.

The fæces of each recruit were collected in a numbered chamber-pot. A teaspoonful, approximately three grammes, was removed by an orderly and emulsified thoroughly in a saturated solution of ordinary sodium chloride contained in a sixty-cubic-centimetre porcelain ointment pot. This emulsion was filtered through a double layer of gauze into a small Erlenmeyer flask of 80 to 100 cubic centimetres capacity, which was then filled to the neck with saturated solution of sodium chloride (fig. 1). In a few minutes all ankylostoma ova floated to the top of such a solution, so by the time the last of the series of emulsions had been prepared the first was ready for examination. With a stout wire loop the top layer of the emulsion was

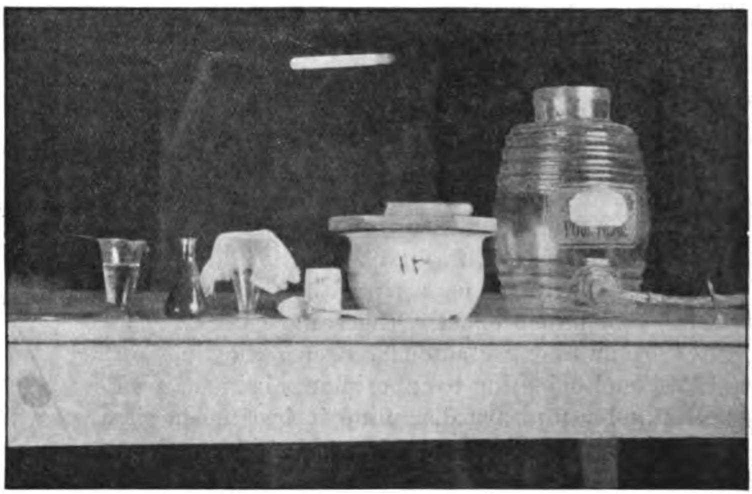


FIG. 1.—Apparatus for examination of fæces.

removed and placed on a slide, three or four dips serving to remove the whole of it, and with it practically all the ankylostoma ova in the original three grammes of fæces. A proportion of ascaris, tænia, and schistoma ova are also floated by this method. The findings were noted in the appropriate columns of the special form. Lastly a yellow index card was prepared for each patient.

The results of this examination are shown in Table I.

TABLE I.

Number of recruits examined	292
Number of recruits found to harbour parasites	265
Percentage ,, ,, ,, ,,	91

Nature of infestation	Number infested	Percentage infested
Ankylostomiasis	212 ..	73
Schistosomiasis	152 ..	52
Ascariasis	20 ..	7
Other infestations ..	9 ..	3

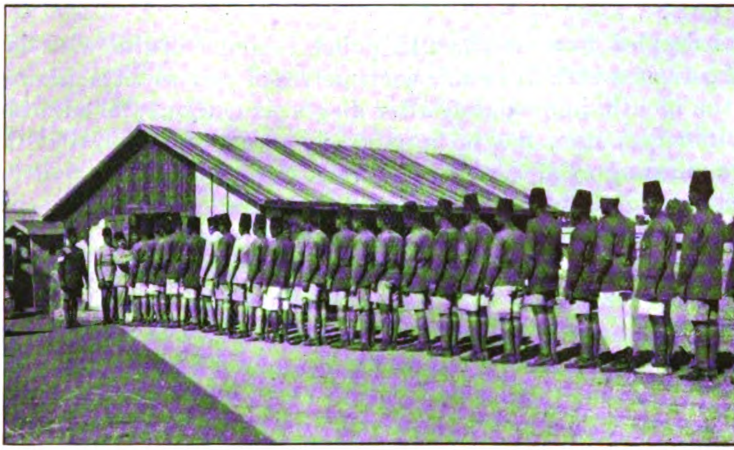


Fig. 2.—Administering carbon tetrachloride.

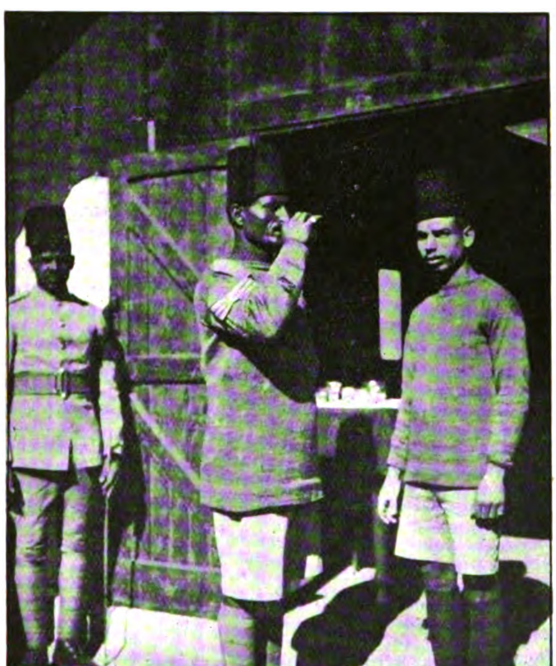


Fig. 3.—Swallowing the dose.

(4) The Treatment of Ankylostomiasis with Carbon Tetrachloride.

It was decided to treat the 212 police school recruits who harboured intestinal parasites with five cubic centimetres of carbon tetrachloride, given plain by the mouth, immediately after diagnosis without the administration of a preliminary purge, but on a naturally empty stomach, that is to say before the morning meal (figs. 2 and 3). A purge of twenty-five grammes of magnesium sulphate in fifty cubic centimetres of water was given two hours after the administration of the carbon tetrachloride.

The after effects were strikingly mild. The majority of the men experienced no symptoms whatsoever, whereas the minority complained only of slight epigastric discomfort, dizziness, and, in a few cases, nausea. One man only said he felt very sick, but even he did not vomit. The men

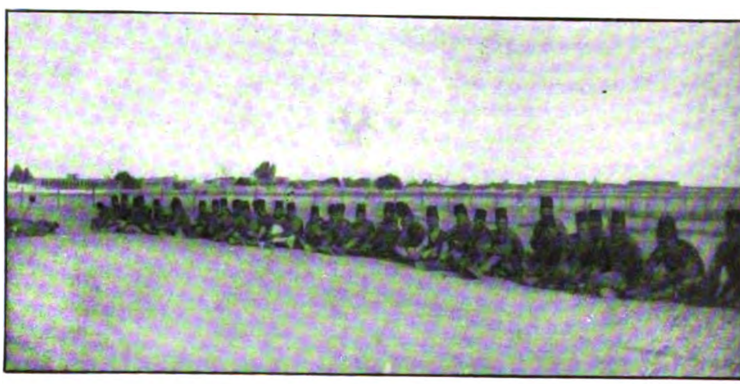


Fig. 4.—Unaffected by carbon tetrachloride.

with symptoms were separated from the men with none, and in a short time it was noticed that the former were all lying down and silent whilst the latter continued to sit up and joke and chat with their comrades (fig. 4).

All the men were carefully re-examined three months later. Seventy-nine per cent were found to have been completely cured, whilst the condition of the remainder had so greatly improved that three grammes of fæces would only yield an occasional ovum after prolonged search in cases in which the same quantity of fæces before treatment had yielded field after field packed with ova.

At Wadi Halfa Quarantine, in 1920, I treated 12,500 men with four grammes of thymol, and 1,500 men with three cubic centimetres of chenopodium oil, and I can safely say that for efficacy, ease of administration, mildness of after-effects, safety and cheapness, carbon tetrachloride is incomparably the best anthelmintic yet discovered for the mass treatment of ankylostomiasis amongst Egyptians.

(5) Disposal of Arguments advanced against the Use of Carbon Tetrachloride.

In the course of this and subsequent work, certain arguments were advanced against the use of carbon tetrachloride which it will be convenient to dispose of now.

On the strength of an unrecorded experiment, conducted with one litre of the medicine, it was alleged that it would only cure one per cent of cases. This argument is untenable, as the statistics of the Public Health Department of Egypt show that 6,000 cases of ankylostomiasis were treated with carbon tetrachloride at Qualioub Anthelmintic Annexe in 1923, and that seventy-six per cent were cured. It was also possible at a later date to quote my own carefully controlled experiment, which fully confirmed this result.

It was alleged that carbon tetrachloride was a dangerous medicine, about which we ought to know more before using it on a large scale. This argument would have been valid had it not been very generally known at the time it was advanced that the effects of carbon tetrachloride are mild and evanescent in the extreme compared with those following the administration of thymol and chenopodium oil, and that such cases of poisoning as had been recorded took place in the early days, and had long since been proved to be due to the effects of carbon bisulphide—a very poisonous impurity present in commercial carbon tetrachloride. Moreover, the experiments conducted in the Public Health Laboratories in Egypt had shown that a dog could without injury take a dose of eight cubic centimetres per kilogramme of body weight, which is equivalent to a dose 100 times larger than that actually administered to human beings in practice. Its harmlessness was further vouched for by the fact that, as the result of the human and animal experiments conducted by the Public Health Department of Egypt, the medicine was at that time being used in the four anthelmintic annexes, in all the Government hospitals, and in most of the private hospitals in Egypt.

One very unusual argument advanced, presumably as a reason for not treating the sufferers at all, was that a better medicine might be found. One had almost apologetically to point out that a better medicine than carbon tetrachloride might and probably would be discovered, but the principles underlying mass diagnosis and treatment with the best medicine available would always remain the same.

(6) Organization of Routine Measures for Mass Diagnosis of Schistosomiasis amongst Egyptian Army Recruits.

The urines of recruits were collected in conical glasses bearing their respective numbers. A special form of glass with a rounded bottom was used (fig. 6, A), the ordinary type with a pointed bottom (fig. 6, B) being unsuitable on account of the difficulty of getting at the ova except with the use of a very fine pointed pipette which is easily broken. As the collection

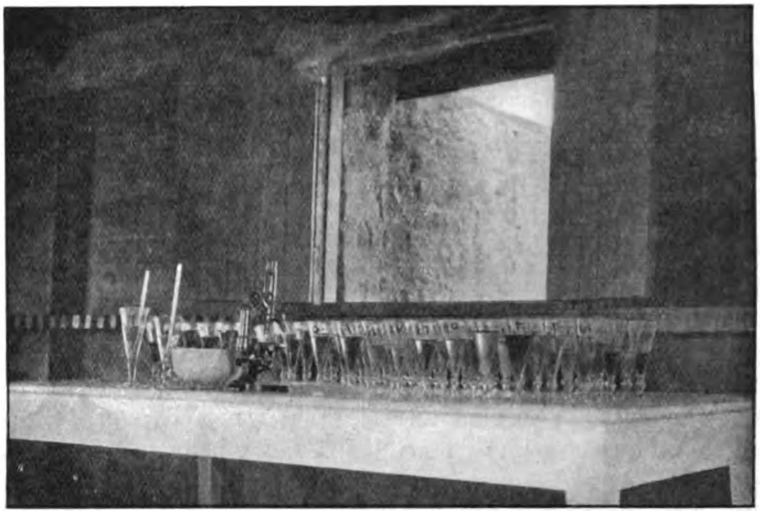
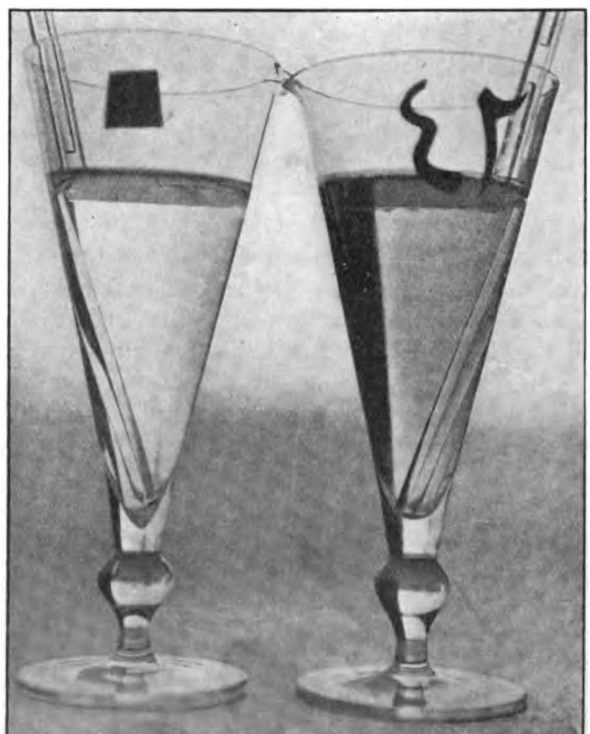


Fig. 5.—Urines ready for examination.



B **A**

Fig. 6.—Urine glasses.

B = the wrong type. A = the right type.

of urine was the first item on the day's agenda and its examination the last, the process of sedimentation was always complete in plenty of time. Sedimentation of the whole urine naturally yields a higher percentage of positive results than centrifugalization of a portion of it, so where time is no object it is the better method. The glasses must, of course, be kept scrupulously clean, and should be stored bottom up when empty, and kept covered when full, so as to exclude dust.

After allowing time for blood, pus, and ova to settle, one or two drops were transferred by pipette from the bottom of the glass to a slide and examined under the low power without a coverslip. The presence of blood, pus, or ova, was noted in the appropriate column of the special form, these data being entered subsequently on an index card.

(7) The Treatment of Schistosomiasis with Antimony Sodium Tartrate.

It was decided to treat schistosomiasis with antimony sodium tartrate. The required quantity of a six per cent solution (one grain to one cubic centimetre) was prepared and sterilized each day for use the following day.

The course consisted of twelve intravenous injections given on alternate days, Fridays excepted. The first dose was 0·5 grain, the second 1 grain, the third 1·5 grain, and the fourth and subsequent doses 2 grains each, making 21 grains in all, thus :—

	First injection	Second injection	Third injection
First week ..	0·5 c.c. ..	1·0 c.c. ..	1·5 c.c.
Second week ..	2·0 ,, ..	2·0 ,, ..	2·0 ,,
Third week ..	2·0 ,, ..	2·0 ,, ..	2·0 ,,
Fourth week ..	2·0 ,, ..	2·0 ,, ..	2·0 ,,

(Each c.c. contains 1 grain of antimony sodium tartrate.)
Total = 21 grains.

Each recruit under treatment was given a red or a blue index card for convenience in checking attendance, those with red cards attending on Saturdays, Mondays, and Wednesdays; and those with blue cards on Sundays, Tuesdays and Thursdays.

Recruits attending for treatment were first checked and lined up. Each man in turn then sat on a chair and placed his bared arm on a table, which was high enough to support it, fully extended from the shoulder (fig. 7). With a sterile swab an assistant swabbed the area at the bend of the elbow with spirit and compressed the upper arm till the veins stood out. A second assistant passed a sterile all-glass two-cubic-centimetre syringe to the medical officer, who filled it to the required mark with the solution, injected the contents into a vein, and replaced the syringe in a tray of tepid water. The assistant transferred it to a tray of hot water, and thence to the sterilizer, a precaution necessary to prevent undue breakage of syringes. Ten syringes kept circulating in this manner served to keep the medical officer fully supplied. The lay-out of apparatus is shown in fig. 8.

Careful attention to every detail of organization is essential for rapid and efficient mass treatment. The success of the arrangements described above was borne out by the fact that they enabled the medical officer to

FIG. 7.—Intravenous injection of antimony sodium tartrate.

FIG. 8.—Apparatus for intravenous injections.

give two or three hundred intravenous injections a day at the rate of one hundred an hour.

Provided that due care is given to aseptic technique, the chief danger to be apprehended is from the escape of solution into the tissues, an accident which causes immediate burning pain at the site of injection, and frequently

results in the formation of an abscess. If steel needles are used, and sharpened daily, such accidents need never occur, as is shown by the fact that between October 1, 1923, and January 31, 1924, 7,215 intravenous injections of antimony sodium tartrate were given in this newly-organized annexe without the occurrence of a single abscess.

Recruits were made to lie down for two hours after receiving their injection, and were not given any drill or physical training on that day. Some experienced no symptoms, whilst others complained of a transient feeling of constriction in the chest and a desire to cough, very slight in most cases. Persistent giddiness, repeated vomiting, pain and diarrhœa—the signs and symptoms of poisoning—were never observed. Recruits were instructed in drill and physical training on the days on which they did not receive an injection.

One hundred and thirty-two of the treated men were available for re-examination six weeks, and again three months, after all treatment had ceased. The results are shown in Table II:—

TABLE II.

	Number of recruits treated for schistosomiasis : 132			
	6 weeks after cessation of treatment		3 months after cessation of treatment	
Findings	No. of recruits	Percentage	No. of recruits	Percentage
Living ova	15	11	7	5
No ova, or dead ova, or blood only	117	89	125	95

The criterion of the death of the worms is failure to find viable ova in spite of careful and repeated examination after a sufficient interval of time has been allowed to elapse in order to give female worms weakened, but not killed, by the treatment a chance to resume the egg-laying function, by which their presence in the veins of the portal circulation is detected. From Table II it would appear that in the great majority of comparatively mild cases of schistosomiasis 95 per cent of the worms are killed by the course of treatment described. If, in spite of the fact that careful search after a sufficient interval reveals no living or dead ova, blood still continues to be passed in microscopic or macroscopic quantities in the fæces or urine, the probability is that it is due to a chronic ulcer, a polypus, or a calcŭlus. The rise in the percentage of cures between the sixth and twelfth weeks shown in Table II is probably due to the natural death of worms poisoned, but not killed outright, by the treatment.

There is every reason to believe that by amplifying the course of treatment described 100 per cent of cures could be obtained amongst recruits. It is quite clear that cure depends upon finding the limit of saturation with antimony sodium tartrate which the patient can tolerate, and maintaining this till all the worms have been killed. The following course of 6 per cent solution of antimony sodium tartrate would be likely to secure this end in the case of comparatively healthy young adult males:—

1st week	..	1·0 c.c.	..	1·5 c.c.	..	2·0 c.c.		
2nd ,,	..	2·0 ,,	..	2·0 ,,	..	2·0 ,,		
3rd ,,	..	2·0 ,,	..	2·0 ,,	..	2·0 ,,		
4th week (*a*) if living ova are no longer present—								
		2·0 c.c.	..	2·0 ,,	..	2·0 ,,		Total 22·5 gr.
(*b*) if living ova are still present—								
		2·5 c.c.	..	3·0 ,,	..	3·0 ,,		Total 25 ,,

Each c.c. contains 1 gr. of antimony sodium tartrate.

The improvement in the health of the recruits was so dramatic that within six weeks the entire permanent staff of non-commissioned officers and men of the Police School asked to be examined and if necessary treated. Even more satisfactory was the opinion of the Commandant, El Kaimakam Ali Bey Zeitoun, who stated that he had never before seen any batch of recruits remain so fit under training and benefit so rapidly from it. This expression of opinion was all the more valuable in that it came from an officer who, it will be remembered, was originally entirely opposed to the scheme. He became such an ardent propagandist that news of the work eventually reached the ear of His Excellency Mahmud Pasha Azmi, Minister of War and Marine, in the Yehia Ministry, and finally of His Majesty King Fuad I of Egypt, who, ever solicitous of the welfare of his troops, gave immediate orders for the rank and file of the bodyguard to be examined and treated forthwith.

(8) Disposal of Arguments advanced against the use of Antimony Sodium Tartrate.

In the course of this and subsequent work many arguments were advanced against the use of antimony sodium tartrate in the manner recommended. These it will be convenient to dispose of now.

In the first place it would be as well to explain that antimony sodium tartrate, being more soluble and less toxic than antimony potassium tartrate (tartar emetic), has now largely replaced that salt for the treatment of schistosomiasis in Egypt. Possibly the lithium salt will eventually be found to be more suitable than either. Emetine is also extensively and successfully used for the treatment of schistosomiasis, sometimes alone and sometimes in combination with antimony salts; it is much more toxic than either of the latter. It owes its reputation in part at least to the effect it has on amœbic dysentery, which not infrequently exists with, and is overshadowed by, schistosomiasis of the rectum.

It was alleged that antimony salts might have a deleterious effect on the heart.

The earliest signs and symptoms of an excessive dose are severe coughing and feeling of constriction in the chest, persistent giddiness, repeated and violent vomiting, colic and diarrhœa. Even these symptoms are not an indication for stopping treatment but merely for lowering the dose. When a poisonous dose of an antimony salt is administered all the above signs and symptoms are greatly exaggerated, the pulse

is slow and weak, the blood-pressure falls, respirations are slow and laboured, depression is marked, collapse sets in and finally death supervenes. The signs and symptoms of chronic poisoning due to the repeated administration of excessive but non-fatal doses are general weakness, depression, headache, giddiness, drowsiness, confusion, indistinct sight, and sometimes diarrhœa. Ultimately fatty degeneration occurs in many of the organs. In the treatment of schistosomiasis we are dealing with a relatively very small quantity of the medicine, twenty to thirty grains in all, divided into small graduated doses, administered over a period of twenty-eight days. Up to 200 grains have been given to patients suffering from trypanosomiasis without producing any ill-effects. There is in fact not the slightest evidence to show that in therapeutic doses antimony salts have any deleterious effect whatsoever on heart-muscle.

The theory that antimony salts damage heart-muscle rests on faulty clinical observation. It is quite true that if a given number of patients suffering from schistosomiasis are examined after a course of treatment with antimony salts a proportion are found to have signs of heart disease. But if an equal number of patients are examined before treatment is begun an exactly similar proportion are found to have heart disease already. Finally, if care is taken to detect those who already have diseased hearts before treatment is begun, it is found that none of the remainder develop signs of heart disease either during treatment or subsequently, whilst those who already have diseased hearts are not made any worse by treatment.

The explanation of the occurrence of heart disease in untreated cases is probably that they suffer from a mild degree of fatty degeneration of the heart, which is very common in Egypt, as a result of the anæmia and debility produced by chronic infestation with parasitic worms. Many of the men who break down under the stress of army service would undoubtedly have gone through life in a civil capacity without developing any signs of heart disease. Some break down as recruits, but most of them after two or three years' service. It is amongst the latter class of men whose health has gradually declined, till they have had to be admitted to hospital, that diseased hearts are more prevalent.

In order to see if antimony sodium tartrate had any deleterious effect on heart muscle, such as was alleged, observations were made on fifty-five consecutive cases of schistosomiasis found amongst recruits. They were examined before treatment, after they had received seven grains and after they had received nineteen grains. At each examination the pulse-rate was examined before a standard exercise test, which consisted in stepping six times on to a chair, and again after the test, ninety seconds rest being allowed for the pulse-rate to return to normal. Failure of the pulse-rate to return, after ninety seconds rest following standard exercise, to approximately the same rate as before standard exercise, was regarded as a manifestation of serious derangement of the heart, in all probability fatty degeneration of the myocardium, the result of chronic intoxication due to

the effects of long-standing infestation with parasitic worms. The fifty-five cases were therefore divided into two classes: (*a*) those in whom the pulse-rate was approximately the same before and after standard exercise, (*b*) those in whom there was a difference of more than ten beats in the pulse-rate before and after standard exercise. It is in the latter class, if anywhere, amongst the men with hearts already damaged by disease, that one would have expected to find some manifestation of the alleged injurious action of antimony salts on heart muscle.

The results are shown in the Tables III and IV.

TABLE III.—AVERAGE PULSE-RATES OF FORTY-SIX RECRUITS WITH NORMAL HEARTS.

Before treatment			After receiving 7 gr. A.S.T.			After receiving 19 gr. A.S.T.	
B.E.	A.E.		B.E.	A.E.		B.E.	A.E.
79	81	..	82	86	..	79	83

B.E. = Before standard exercise test.
A.E. = After standard exercise test.
A.S.T. = Antimony sodium tartrate.

Table III shows that under the combined influence of military training and treatment practically no difference was found in the pulse-rates before and after standard exercise of recruits whose hearts were normal before treatment was begun. A slight increase in both rates was apparent after treatment with seven grains and training for ten days, but they had returned to normal by the twenty-fifth day, in spite of the fact that the recruits had received another twelve grains of antimony sodium tartrate and undergone another fifteen days' training. The presumption is therefore that this slight temporary increase must have been due to the effects of training.

TABLE IV.—AVERAGE PULSE-RATES OF NINE RECRUITS WITH ABNORMAL HEARTS.

Before treatment			After receiving 7 grs. A.S.T.			After receiving 19 grs. A.S.T.	
B. E.	A. E.		B. E.	A. E.		B. E.	A. E.
88	108	..	99	103	..	102	108

Table IV shows *inter alia* the wide average difference found in the pulse-rates before and after standard exercise of some sixteen per cent of "fit" recruits suffering from schistosomiasis who had not yet received treatment or undergone training. After treatment with seven grains and training for ten days the rate before exercise was found to be markedly increased, and, instead of returning to normal, it became, if anything, slightly faster as the result of treatment with another twelve grains, and training for another fifteen days. In view of the findings in the case of the forty-six men with normal hearts it seems reasonable to infer that the deterioration observed in the case of the nine men with hearts already deranged before treatment was the outcome of military training, and not of the administration of antimony sodium tartrate.

From these observations it is clear that antimony sodium tartrate can be administered with perfect safety to recruits with normal hearts in the doses and at the intervals recommended.

It is also clear that by taking suitable precautions it should be possible in future to eliminate at the final medical examination of recruits all those with hearts liable to break down during recruit training.

Further proof of the value and harmlessness of antimony sodium tartrate is furnished by the statistics, not yet published, of the Public Health Department of Egypt for 1923, which show that during that year no less than 29,000 patients of all ages and both sexes were treated with it at the four anthelmintic annexes, without the occurrence of a single casualty proved to be due to the medicine. As these patients all attended voluntarily, in spite of the fact that the course of treatment involves considerable personal inconvenience to the patient, and is somewhat alarming to the uneducated mind, no more convincing proof of the essential efficacy and harmlessness of the medicine could be forthcoming.

It would therefore be unreasonable, uneconomical, not to say inhuman, to withhold treatment from infested but otherwise healthy recruits on the groundless supposition that their hearts might be damaged by the treatment, especially as we know definitely that if they are not treated many will inevitably be invalided as hopeless wrecks before they have completed five years' service.

Another argument advanced against mass treatment was that cases of schistosomiasis treated with antimony sodium tartrate had been known to relapse. The word relapse, as commonly used in this connexion, conveys a totally erroneous impression of what usually occurs. It is quite true that, if in any given case treatment is inadequate, the worms will not all be killed, and after an interval signs and symptoms of active schistosomiasis will reappear. This is a relapse. It is also true that in some cases, in spite of drastic treatment which has resulted in the death of all the worms, patients continue to suffer from severe and intractable signs and symptoms of the disease, to which they eventually succumb. This is especially true of the rectal form of schistosomiasis. The great majority of so-called relapses belong to the latter category in which the signs and symptoms of the disease persist in spite of the death of the worms. The decisive factor in these cases is of course extensive and irreparable tissue damage. It is therefore wrong to describe them as relapses and doubly wrong to lay the blame of failure upon antimony sodium tartrate. Its warmest advocate never claimed that it could do more than kill off all the schistosomes in a human body, provided it was administered in adequate doses at suitable intervals. In any case, of course, the occurrence of occasional relapses would no more be an argument against the use of antimony sodium tartrate in the treatment of schistosomiasis than it would be in the case of quinine in malaria, or salvarsan in syphilis.

Christopherson and a host of workers in Egypt have long since condemned pusillanimity in the administration of tartar emetic. It is widely known that by giving inadequate doses of antimony salts at excessive intervals the worms, far from being killed, are merely stupefied, and, what

is worse, gradually accustomed to withstand the medicine till it becomes practically impossible to kill them without jeopardizing the patient's life, or at any rate causing the manifestation of serious intestinal symptoms. It cannot be too often or too strongly reiterated that the whole art of curing schistosomiasis with antimony salts consists in saturating the patient, and keeping him saturated, till all the worms are dead.

It was alleged that antimony salts are not as efficacious against schistosomiasis of the rectum as they are against schistosomiasis of the urinary bladder. This is not the case. As already pointed out, it is the serious complications of the former disease that are incurable with antimony salts. They cannot be expected to remove chronic ulcers, polypi and papillomata of the rectum and large intestine, complications which commonly persist in spite of the death of the worms. It is the sapping of the patient's vitality by hæmorrhage and the poisoning of his system by septic absorption that constitute the serious feature in cases of advanced rectal schistosomiasis.

Another argument advanced against mass treatment was the fact that in the month following that in which mass treatment of recruits was begun, an unusually large number of men had been invalided from the Egyptian Army General Hospital, Cairo. The fact that it had been found necessary in that month to invalid a large number of men whose disease had not been diagnosed when they entered the army some years previously, and whose health had steadily deteriorated till it had passed beyond medical aid, far from being an argument against a system of which they had never had the benefit, was the strongest possible argument in favour of it. No amount of argument, especially of the specious sort which seeks to foist the failures of a broken-down system on to a struggling new one, can ever justify the policy of standing idly by till diseased men have become so seriously ill as to require admission to hospital and then, after some of them have already reached the incurable stage, undertaking their treatment. Even if all the men referred to had been recruits, which was not the case, it would still have been possible to maintain on grounds of humanity, economy and efficiency that they were better invalided as recruits in the same condition as they were in when they joined the army, than as serving soldiers, broken in health, and therefore no longer able to earn a livelihood.

Another argument against treatment was that treated men would become reinfested on furlough. Reinfestation will no doubt occur occasionally, but there is no reason for entertaining an exaggerated idea as to its danger. When due consideration is given to the fact that it has taken twenty-one years of life and work as fellahîn for fifty per cent of recruits to become infested, it becomes apparent that the percentage of serving soldiers likely to become infested during a total of seventy-five days' furlough in five years' service will be so extremely small as to be negligible. If progressive infestation did occur to any serious extent during service one would expect to find a higher percentage of infested men amongst serving

soldiers than amongst recruits, but the reverse is the case, the figures being forty per cent and forty-nine per cent respectively, the difference no doubt being due to treatment and invaliding of serving soldiers. The soldier on furlough does not work as a fellah; he leads for a brief spell the lordly life of an idle and opulent man. In any case the danger of reinfestation is not an argument against the treatment of schistosomiasis any more than it would be in the case of malaria or venereal disease.

(9) The Exact Extent of Parasitic Worm Infestation in the Egyptian Army.

Attention was next directed to recruits for the army and to serving soldiers. All recruits of the 1923 winter call and all the serving soldiers in Cairo, comprising His Majesty's Household troops, detachments of cavalry and artillery, and the 2nd, 4th and 8th battalions were systematically examined between October 4, 1923, and February 10, 1924. The results are shown in Tables V and VI.

TABLE V.—Examination of the 1923 Winter Call of Recruits for the Egyptian Army.

	Number examined	Ankylostomiasis		Schistosomiasis of urinary bladder		Schistosomiasis of rectum		Other infestations		Infested	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Recruits ..	1,264	745	59	619	49	2	0·3	79	6·2	959	75·9

TABLE VI.—Examination of Soldiers of the Egyptian Army serving in Cairo.

Unit	Number examined	Ankylostomiasis		Schistosomiasis of urinary bladder		Schistosomiasis of rectum		Other infestations		Infested	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Household troops	438	159	36·5	151	34·5	1	0·2	8	1·8	253	57·7
Cavalry ..	128	50	39·0	44	35·2	—	—	2	1·5	78	61·0
Artillery ..	200	137	68·5	66	33·0	—	—	1	0·5	151	78·5
2nd Battalion	534	198	37 0	190	35 5	7	1·3	8	1·5	319	59·8
4th ,,	465	304	65·4	218	46·9	13	2·8	30	6 4	383	82·4
8th ,,	587	279	45·8	277	45·3	2	0·3	38	6·4	420	71 6
Total	2,352	1,127	47·9	946	40·2	23	1·0	87	3·7	1,604	68·1

Thus it is seen that seventy-six per cent of recruits and sixty-eight per cent of soldiers with from one to four years' service were found to be suffering from one or more, in some cases four kinds of parasitic worm infestation. As large numbers of men are being treated or invalided every year for these diseases it is manifestly absurd to ascribe the difference in percentage to natural cure.

Variations in the percentage of infested men in different units depend upon the areas from which the majority of recruits in these units were drawn. Thus it will be seen in Table VI that 2·8 per cent of the men in the 4th Battalion have rectal schistosomiasis, a much higher proportion than any other unit examined; this is due to the fact that the 4th Battalion

contains a relatively large proportion of men from the Fayoum Province, an oasis to the west of Egypt, in which rectal schistosomiasis is much more prevalent than anywhere else in the country. Again, both the 4th and the 8th Battalions have a higher percentage of men with schistosomiasis of the urinary bladder than any other units examined; this is because the majority of the men in these two battalions are drawn from the Delta area (Lower Egypt) in which this form of the disease is much more prevalent than in the valley area (Upper Egypt).

It seemed advisable to push the investigation one step further by examining the ninety-eight officer cadets in the Military School, Cairo, and the fifty-two medical students from Kasr el Aini Hospital seeking medical education at Government expense with a view to serving subsequently in the Medical Corps. The result is shown in Table VII:—

TABLE VII.—EXAMINATION OF OFFICER CADETS IN THE CAIRO MILITARY SCHOOL.

Number examined	Ankylostomiasis		Schistosomiasis of urinary bladder		Other infestations (chiefly *Tænia nana*)		Infested	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
150	5	3·5	20	13·3	6	4	31	20·6

20·6 per cent of these boys, who came from relatively good social surroundings, were thus found to be infested. Before the examination was carried out they were all asked if they had "bilharzia," and all denied it. After the examination those found to have schistosomiasis of the urinary bladder all admitted that they knew they had the disease, and in every case they were able to state the year in which they contracted it, and were even able to associate infestation with bathing in particular canals whilst staying in the country. The infestations were all light. It is interesting to note that renal colic with atypical symptoms is a fairly common complaint amongst Egyptian officers and men. Genuine cases of course occur, due to the presence of stone in the kidney, but many of these atypical cases are almost certainly due to the presence of stray ova in the kidneys and ureters.

(10) SUMMARY OF WORK CARRIED OUT IN THE ANTHELMINTIC ANNEXE OF THE EGYPTIAN ARMY GENERAL HOSPITAL, CAIRO, BETWEEN OCTOBER 1923 AND FEBRUARY 1924.

1,445 recruits suffering from schistosomiasis, ankylostomiasis, and other intestinal infestations, and 1,214 serving soldiers suffering from ankylostomiasis and other intestinal infestations received appropriate treatment, whilst 969 serving soldiers found to be suffering from schistosomiasis had their names noted for treatment in March, 1924, on the conclusion of the winter training season.

3,756 men were examined, involving the microscopical examination of 8,128 specimens of urine and fæces.

2,038 doses of carbon tetrachloride were administered.

621 men were treated for schistosomiasis, involving the administration of 7,450 intravenous injections of antimony sodium tartrate.

The staff consisted of a portion of the existing staff of the Egyptian Army General Hospital, Cairo, namely, myself, El Yuzbashi (captain), Ibrahim Effendi Rizk, and three anfar (privates) of the Egyptian Army Medical Corps.

Before I left Egypt in March, 1924, very encouraging reports were being received from officers commanding units and medical officers doing duty with troops. The gist of these was that whereas in previous years numbers of recruits used to faint on parade and several had usually to be admitted to hospital for schistosomiasis before their training was complete, this year none at all had fainted or reported sick with schistosomiasis, a result which they unanimously attributed to the introduction of mass diagnosis and treatment. All were most anxious that the work should continue.

The cost of dealing with the 1923-24 batch of recruits worked out at well under the original estimate of £50.

(11) Summary and Conclusions.

(1) Fourteen per cent of the soldiers treated in the Egyptian Army General Hospital in Cairo, in 1923, were admitted primarily for parasitic worm infestation.

(2) Twenty-nine per cent of the men invalided in 1923 from the same hospital were invalided for the effects of chronic infestation with parasitic worms.

(3) Large numbers of "fit" men in the Egyptian Army suffer constantly from signs and symptoms of parasitic worm infestation without feeling ill enough to report sick.

(4) The Egyptian soldier is notoriously lacking in resistance to the adversities of military service in a bad climate. There is every reason to believe that this is the direct result of his constitution having been undermined by chronic infestation with parasitic worms.

(5) Ninety-one per cent of a batch of 292 recruits for the Police School, Abassia, Egypt, were found to be infested with parasitic worms, some harbouring as many as four kinds. 73 per cent had ankylostomiasis, 52 per cent schistosomiasis, 7 per cent ascariasis, and 3 per cent other infestations.

(6) The 212 ankylostomiasis cases were treated with a single dose of five cubic centimetres of carbon tetrachloride. Three months later seventy-nine per cent were found to have been completely cured. For efficacy, ease of administration, mildness of after effects, safety and cheapness, carbon tetrachloride is incomparably the best anthelmintic yet discovered for the treatment of ankylostomiasis amongst Egyptians.

(7) The 152 schistosomiasis cases were treated with twenty-one grains of antimony sodium tartrate divided into twelve doses and given on

alternate days by intravenous injection. Of the 132 who were available for re-examination three months later, ninety-five per cent were found to have been completely cured. By amplifying the dose on the lines indicated it is probable that 100 per cent of cures could be obtained in these comparatively lightly-infested healthy-looking recruits. Cure depends upon finding the limit of saturation the patient can tolerate and maintaining it till all the worms are dead. Antimony sodium tartrate merely kills the worms ; it cannot be expected to repair hopelessly-damaged tissues.

(8) Of a batch of fifty-five recruits forty-six with normal hearts suffered no harm from a full course of antimony sodium tartrate, and underwent training during their course of treatment. Nine who showed evidence of more or less serious derangement of the heart before treatment became worse under the combined influence of training and treatment; as those with normal hearts were unaffected the presumption is that the men with already deranged hearts were adversely affected by training and not by treatment.

(9) The derangement of the heart found in sixteen per cent of apparently fit recruits is probably the outcome of chronic toxæmia ; due to long standing infestation with parasitic worms.

(10) The necessity for subjecting all recruits for the Egyptian Army to a simple test for cardiac efficiency was clearly demonstrated.

(11) Seventy-six per cent of the 1923-24 winter call of recruits for the Army, picked fellahîn with every appearance of perfect health, were found to be suffering from parasitic worm infestation, fifty-nine per cent having ankylostomiasis and forty per cent schistosomiasis.

(12) Sixty-eight per cent of soldiers serving in Cairo were found to be harbouring parasitic worms, fifty-nine per cent having ankylostomiasis and forty per cent schistosomiasis.

(13) Twenty-one per cent of officer cadets were found to be suffering from parasitic worm infestation, three per cent having ankylostomiasis and thirteen per cent schistosomiasis.

(14) A complete case has been made out on grounds of expediency no less than of humanity for the immediate application of the methods of mass diagnosis and treatment to the rest of the Egyptian Army, and for the routine examination and treatment of all recruits in future, before they join their units, on the lines indicated in this paper.

THE DENTAL CARE OF THE SOLDIER.

By Lieutenant-Colonel J. P. HELLIWELL, C.B.E.
The Army Dental Corps.

An Informal Talk to the Officers attending the Course in Hygiene at R.A.M. College, February, 1925.

I ought to attempt in the first place to outline briefly the history of Army Dentistry, but its development from its birth to its present childhood has occurred within so few years that it is well known to most of us. Prior to 1902, when a few civilian dental surgeons were employed in the Army, we can definitely say that the dental care of soldiers consisted of treatment of the most casual kind. It had not, at that time, been fully realized what an important part diseased teeth and septic mouths play in regard to general health. In fact we can say that dentistry as now known and practised was just beginning to be noticed, and before that time oral sepsis was not always considered in the ætiology of the conditions in which it is now acknowledged to play so great a part. This may to some extent be due to the insufficient advance in dental teaching at a time when, for example, pathology did not hold the place it now does in the curriculum of medical and dental students. Consequently, in those days, the older officers of the Medical Services—officers who would hold administrative appointments—could not have the knowledge and enlightenment that the study of dental diseases has brought us. How many of the large dental hospitals and dental schools, or large dental departments in general hospitals, were developed to an extent in any way approaching their present state, and how many of the senior officers who qualified in say the early eighties had any contact with dental teaching?

The question is, was the need of dental treatment existent to the extent that it is now—was dental disease so prevalent or were we just ignorant of its extent and significance? It is a conjecture, as statistics are very meagre, but I share the opinion that its prevalence has increased rapidly during the last two or three generations. Most people of all classes have the history of grandparents or even parents who died at goodness knows what age "with every tooth in their heads." Our grandfathers certainly had not the facilities for obtaining packets of all kinds of predigested or peptonized foods. When they dined they dined and masticated. Their appetites had not to be cozened by succulent French menus. Their teeth had work to do, so they remained vital and resistant to the local influences which now attempt the destruction of our teeth. If we look at the average skull of two or three generations ago we shall find in the majority of cases that the cusps of the back teeth are flattened by wear and to some extent

denuded of enamel. The cutting edges of the front teeth are also considerably worn and may show indications of a powerful "edge-to-edge" bite, suggesting that these teeth were not meant for ornament. In these days it is not usual for the teeth to show any considerable signs of wear, the cusps are present and covered with enamel, and there is a tendency for the roots of the third molars to fuse and for the whole tooth to become stunted. When considerable wear is seen in teeth it is seldom that extensive caries is co-existent. But it is not my business to talk about the cause of dental caries. What concerns us chiefly is that dental caries exists among the soldiers, and if left untreated it will impair their efficiency. There is therefore the demand for dental service.

We have to consider whether by judicious selection of recruits of good dental standard we can afford to run the risk of their teeth not remaining in fairly good condition during the normal period of military service. As you know, men now presenting themselves for enlistment are rejected if they do not possess the number of teeth necessary for efficient mastication, but this by no means implies that the men enlisted have sound teeth. We still find that well over ninety per cent of these recruits have carious teeth. The caries is practically always active and progressive. Say the recruit enters the Army at the age of 18 or 19—during the next few years the progress of the disease will probably be greater than at any other period in his life. Some evidence of this has been shown by the statistics obtained from the examination of many thousands of men of all classes during the war. The number of men of the ages 18 and 30 with dental caries was practically the same, but among the younger men the number of seriously involved teeth per man was small in comparison with that among the older men, as is shown by the fact that the necessity for dentures in the younger class was under one per cent (under the present scheme of selection this percentage of men would be rejected), whereas in the older class it ranged from ten to fifteen per cent. It is of the utmost importance that this rapid progress of dental disease should be dealt with as early as possible and the potential inefficiency caused by the wearing of artificial dentures prevented. We must therefore have a sufficient number of dental surgeons to deal with incoming recruits immediately in order to give them treatment of a conservative nature and so enable them to retain as far as possible during the whole of their period of engagement the natural masticating power with which they join.

The need for Army dental service being definite, we have to decide what is the extent of dental disease or dental deficiency likely to impair a man's efficiency as a soldier. In other words, what is the extent of the risk we can run with regard to these conditions? One thing all are agreed on is that a recruit should not be accepted who requires artificial dentures or who is likely to require them in the immediate future. Therefore it was necessary to fix a standard, in order to aid medical examiners of recruits to decide as to the masticating power of the men. The old instruction con-

cerning the teeth of the recruit was "The acceptance or rejection of a recruit on account of loss or decay of teeth will depend on the consideration of the relative position of the sound teeth and the physical condition of the recruit; thus, the loss of many teeth in a man of indifferent constitution would point to rejection, whilst a robust recruit who had lost an equal number might be accepted." This, of course, was no standard at all; it was a guide and simply meant that a recruit could be accepted if he was in robust health—irrespective of the condition of his teeth. It was not definite and was open to different constructions. The instructions regarding the dental condition of a candidate for a commission were, until quite recently: "That his teeth are in good order. Loss or decay of ten teeth will be considered a disqualification. Decayed teeth, if well filled, will be considered as sound. Non-erupted wisdom teeth should not be counted as deficient." This was open to serious objection as it was possible for a candidate who had lost only nine teeth to be in a much worse position as regards masticating power than another who had lost as many as twelve or fourteen teeth. For example, in the former case all but one of the upper *or* lower premolars and molars may be deficient, leaving a dental formula similar to $\frac{5\ 321\quad 123}{87654321\quad 12345678}$ which is much worse from a utility point of view than the formula $\frac{765\ 321\quad 123}{765\ 321\quad 123}$ where fourteen teeth are deficient.

The points to consider in fixing a dental standard are: (1) The number of functionally unimpaired teeth, and (2) the condition of those teeth. As regards the standard for the recruit it has been decided that he shall possess at least half of his normal masticating surface and that the teeth concerned shall be sound or in such a condition that they can be made sound. For the convenience of medical officers examining recruits an instruction was issued in 1921 defining in as simple a way as possible a method for judging the masticating surface of an individual. Every upper tooth in good functional opposition to lower teeth was given a definite value and it was on the aggregate value of these teeth that it was decided whether a man had sufficient teeth for efficient mastication. Of all men examined on presenting themselves for enlistment during 1912-13 and recruits subsequently examined within three months of enlistment, about two per cent were rejected on account of the loss or disease of many teeth. In 1920-21 about 3·6 per cent were rejected. It must be borne in mind in this connexion that many men were enlisted "subject to dental treatment" or it would not be possible to reconcile this small number of rejections with the fact that nearly all the men joining the Army require dental attendance. It was interesting to note what effect the fixing of a dental standard for recruits had on the number of rejections for 1921-22. In that year the rejections reached almost five per cent. In 1922-23 they fell slightly to 4·8 per cent, and in 1923-24 they fell further to 3·6 per cent, so equalling the number of rejections before the standard was fixed. When it is considered that dental disease is the most prevalent of all diseases and

affects practically everybody, such a percentage of rejection as 3·6 does not seem excessive, especially when compared with the number of rejections for other reasons.

A point to consider is whether any increase in the number of rejections should influence us in reducing the standard. I think it ought to be considerable before we do so, as one could only look with alarm at a condition in which a large percentage of men were dependent on artificial dentures. We all know of the constant stream of temporary non-effectives during the war on account of deficient teeth and broken dentures. This state of affairs would occur again in the event of a large war and will continue to occur until dental clinics become effective enough to deal efficiently with all the children in elementary schools. In small wars, where chiefly regular troops would be involved, we have now the means to prevent considerable wastage of man power, but it entirely depends on the rigorous maintenance of the present dental standard for recruits and the careful treatment of all men during their period of Army service.

The dental standard for a candidate for a commission now is: "That his teeth are in good order. He must have ten sound teeth in the upper jaw *functionally opposed* to ten sound teeth in the lower jaw. Two of these teeth in each jaw must be molars. Well filled teeth will be considered as sound."

We now come to the actual dental care of the soldier. He has enlisted, say at the age of 18 or 19, and his teeth as regulated by the standard are not hopeless but they are in need of a good deal of attention in order to make them reliable. Take the average man of this type. He is quite ignorant of the use of the toothbrush. His inspection by a dental officer is the first visit he has made to a dentist in his life. No one has ever told him of the effects of dental disease on general health and he is quite apathetic in the matter. His teeth are dirty with a film of food debris at the necks, usually causing congestion of the gum margins (marginal gingivitis). The gums consequently bleed easily, and this is usually the first thing a recruit states on being asked why he does not brush his teeth. There is often a deposit of salivary calculus (tartar) at the necks of the teeth, an average of two teeth are hopelessly decayed and there are sundry saveable teeth (averaging about four) in various stages of decay. This is the picture of the average recruit who confronts the dental surgeon for the first time. Now, it is of very little use treating a man who does not himself co-operate in the treatment, so the first duty of the dental officer is to explain to the recruit in simple language the causes of dental caries and the need for oral hygiene. He must also give practical instruction on the use of the toothbrush. This can be done by lectures to the men collectively, but it is much more satisfactory for the dental officer to explain to them individually when they come up for the first inspection. A considerable amount of tact has to be used. It is no use bullying a man on account of his dirty mouth. It is the first he has heard of it. He actually does

not know his mouth is dirty, and any attempt to blame him for it simply increases our difficulties by inducing him to become sulky and to refuse treatment.

The next duty of the dental officer is to chart the condition of the man's mouth. This is done for every soldier on two forms, the Medical History Sheet and the Dental Treatment Card. The chart in front of the Medical History Sheet is kept as a permanent record of a soldier's dental condition on enlistment and it is not subsequently altered. There is also a space on another part of this form for particulars of dental treatment received subsequent to enlistment and these are entered by the dental officer on completion of the treatment the man will receive from time to time.

The Dental Treatment Card is in the charge of and is used solely by the dental officer responsible for a man's treatment and it accompanies the soldier on any change of station. By the system now adopted the dental officer should have before him the Dental Treatment Cards of all the men for whose dental treatment he is responsible, and as the dental condition should be accurately charted on these on the soldier's enlistment and revised at an annual inspection every March, he has constantly in review the actual dental state of the men almost as clearly as if the men themselves were always present. When a man's treatment is completed for the time being these cards are filed separately from the current treatment ones. These latter are again subdivided in accordance with the urgency of the treatment required.

Now to state the extent of treatment. It must have limits; we cannot with the number of dental officers we are allowed do all the treatment usually done by the private practitioner. Our first object is to aim for a clean mouth with the minimum of sacrifice to the masticating surfaces. We cannot do gold restorations to teeth, make gold bridges and crowns, or fill up with artificial appliances all existing small gaps. The æsthetic question has necessarily to be disregarded, unless, of course, it is incidentally a necessity in bringing a trained soldier up to the standard.

It is gratifying to be able to record, even in the present early days of The Army Dental Corps, that quite a revolution in methods is taking place. For instance, four years ago for every tooth saved two were extracted; now, for every tooth extracted three are saved. The influence of this on the number of artificial dentures supplied can easily be imagined. The number of dentures supplied in proportion to the number of men for whom treatment was completed in 1920 was 6·5 per cent; in 1921 it was 4·4 per cent. The following year it was reduced to 2·4 per cent and at the present time it is well under two per cent. This means that we can look forward to the time when there will be exceedingly little wastage in small wars on account of dental deficiency.

An interesting point is that the number of repairs to dentures, however well they may be made, is constantly in excess of the number of new dentures supplied.

Now, a man entering the Army with the full number of teeth required by regulations should not require a denture during his normal period of service. Dental surgeons are attached to each depot and recruits are brought before them within a week of their enlistment. The dental officers have instructions that they must, if possible, keep pace with the treatment of all incoming recruits and avoid letting any slip through the depot to their battalions untreated. From a surgical point of view this treatment should be of the highest order. Every tooth which can be usefully saved and made surgically clean should be treated. Only hopelessly decayed teeth and septic stumps are extracted. The material used for restoring back teeth is an amalgam of silver, tin and mercury; it is quick and efficient. Some consideration is shown for the men with regard to their front teeth, care being taken to match the cements used to the colour of the teeth, and this is greatly appreciated by those who take an interest in their appearance. Moreover, these cements are translucent and the restorations are often indistinguishable. The fitting of artificial crowns to teeth is not usually permitted in the Army. However well fitting these crowns may be it is hardly possible to avoid some kind of a junction between the root and the crown. This unction is naturally very difficult to keep clean, especially as it is always at the gum margin. In the event, however, of a front tooth being badly broken down leaving a root which is or can be made sterile, there is generally no objection to the fitting of a porcelain crown. This is only done in selected mouths. Shell crowns for posterior teeth are not allowed.

For the extraction of teeth a local anæsthetic is always used unless it is contra-indicated. In cases of alveolar abscess or urgent multiple extractions nitrous oxide gas is generally used.

By the systematic treatment of all recruits on enlistment, and by annual inspection, keeping them under observation we should theoretically, and I hope practically, have the whole Army dentally fit in a few years. What we particularly hope to see is the dependence for mastication on the natural teeth, and, as recruits are now treated early, there is every reason to believe we shall approach very much nearer this ideal.

We now come to the arrangements for the treatment of officers. An officer may be afforded treatment to the same extent as other ranks, with the one exception that he may not be supplied with artificial dentures unless his loss of teeth has been caused by wounds received in action or by injuries received in the performance of military duty. In the question of treatment he is not given preference over the men. Nothing is to stand in the way of the treatment of other ranks, but the dental officer can judge what time he has available for officers, and can usually reserve one or perhaps two afternoons a week for them; they attend by definite appointment and interference with their work is reduced to a minimum. Exactly the same materials are used in the treatment both of officers and men; in fact, within useful limits only the best materials are used, so there can be

no discrimination in treatment. It may be that the question of the supply of artificial dentures is purely a financial one; no person is *entitled* to them, but they may be supplied under certain conditions, and these conditions would appear to depend largely on the supposed ability of the individual to pay for them. As other ranks are probably not considered as being in a position to pay for these appliances, it is expedient in the interests of the Service to give them a free initial supply when absolutely necessary. Of course we may have our own private opinions as to the ability of the officer to pay. The persons to whom treatment may be given are not limited to officers and men. The wives and children of soldiers on the married roll have also to be considered. There again the surgical part of the treatment may be given free, and where a soldier's wife requires a denture it may be supplied on repayment at rates laid down by regulations. The officer's wife does not receive treatment unless she happens to be in a station abroad where there is no civil dental surgeon with British qualifications, in which case she may receive treatment of an urgent nature providing it does not interfere with the routine treatment of the troops. Of course, the officers of The Army Dental Corps do not care how many persons may receive dental attendance from them, but as their numbers are in direct proportion to the number of troops, and not to the actual number of persons who may receive attendance, the treatment of families is not likely to be very generous at present. Whatever provisions might be made for the wives, I think it is highly desirable that satisfactory arrangements be made for the attendance on children, and I certainly consider that those attending garrison schools should not be worse off in this respect than children attending elementary schools.

No one will deny in these days of preventive medicine that it is not only desirable, but it is a duty to prevent such a common cause of septic absorption as that arising through bad teeth among the children for whose health we are responsible. At home we are doing our best for these children, but the task is rather a big one, and dental officers have such large numbers of soldiers on their waiting lists that they cannot do all they would like to do in this direction.

The proportion of dental officers authorized for the treatment of troops is at present on the basis of one per 2,000. This proportion was not fixed in a haphazard manner. Many things had to be considered in relation to it. In the first place it had to be decided how many officers would be required for the treatment of incoming recruits. These men require infinitely more attention than men who have previously received treatment, and it was considered that one dental officer would be fully employed in the treatment of 1,000 incoming recruits per year, provided that they were of a decent standard and that approximately seventy-five per cent required attention. This has proved insufficient, as practically every man requires treatment, and as experience has shown that one dental officer can only deal with 600 recruits per year, steps are being taken to increase the

establishment accordingly. Secondly, the proportion of officers required to keep those men fit who had previously received good initial treatment had to be considered. Then the question of leave, sickness, supervision and movements had to be provided for, and considering the recruit to enlist normally on a seven years' engagement, it happened to work out that a dental officer should be responsible for an average of 2,000 men. This proportion was a satisfactory working basis, but it did not necessarily mean that where there were 2,000 troops there would be one dental officer. That would depend on the turnover of the men or, in depots, the rate at which recruits were passed through. Provision had also to be made for men included in drafts in order that they can be made dentally fit before they proceeded overseas.

There are, of course, in the Army many men of some years service who have not received adequate treatment, and I do not think, with the present policy of not allowing any recruit to slip through the depot untreated, that it will ever be possible to catch up these arrears in work, but on the other hand we have the knowledge that these will become fewer and fewer and practically non-existent as time goes on.

There now remains to be mentioned the relation of the medical officer to dental conditions. Where there is a dental officer he has no responsibility with regard to the inspection or the treatment of the men, but in some commands abroad, where the work is done by civilian dental practitioners, he will probably be required to keep an eye on the dental condition of the men and, when he thinks it necessary, to arrange for their treatment and to see that it is carried out within the limits and intentions of the regulations. But whether there is a dental officer or not, we cannot dissociate teeth from the rest of the body in the consideration of any man's general condition. Their influence must be considered, and the better provision of dental service should not prevent the routine examination of the mouth by the medical officer, especially when the teeth can have any influence on any particular condition for which a man may be examined. After the initial treatment the dental officer will probably not see the soldier again for twelve months, and dentistry, like any other branch of surgery, is not an exact science, and consequently there may occasionally be the possibility of something going wrong.

The most usual mistake of medical officers with regard to oral conditions is the diagnosis of pyorrhœa alveolaris. Now this condition is not often found in young people. It is sometimes seen among the older soldiers, but more usually the condition diagnosed as pyorrhœa is a marginal gingivitis caused by the collection of food or tartar at the gum margins. The gums present a very sore and hyperæmic condition, the mouth is dirty and the breath smells. The gums bleed very easily. The congestion of the gums might encroach to some extent on the teeth and give the semblance of distinct pockets and pus, and debris may have collected between these flaps and the teeth. I suppose there is some justification in the diagnosis as there is

undoubtedly some flow of pus; but it is not the true pyorrhœa alveolaris, or Riggs' disease, although untreated it might in course of time become so. The true condition is chronic; there is little congestion of the gums—in fact they are often pale and anæmic. On pressing the gums against the alveolus pus oozes from the more or less deep pockets which always exist (owing to the actual insidious destruction of the bony alveolar margins), and there is usually a distinctive odour which cannot be mistaken. Another condition of the teeth which is often mistaken for active dental caries is the presence of secondary dentine or arrested decay. Teeth showing this condition usually appear to the inexperienced eye to be very bad indeed. They are black or much discoloured and considerably broken down. Close examination with a probe will, however, reveal an intensely hard surface, whilst active decay of dentine is always comparatively soft. Arrested decay is probably as frequently met with in the Army as anywhere. It is the repair, or rather the arrest of disease, in the vital dental tissues which often accompanies an improvement in the general resistance of the body as a whole. The dentine becomes harder than normal on account of dense lime salts being laid down in it; it is usually so dense that the dentinal fibrils are to a large extent obliterated. It is smooth and highly polished and does not contain cracks or fissures. Consequently it is more or less self-cleaning and appears to be more resistant to further disease than normal dentine. As one would expect, it is most frequently found among persons who adopt more healthy conditions of living, regular exercise and a more suitable diet, all of which in the case of a soldier are usually an improvement on those in his previous civil life.

Colonel Sylvester Bradley stated in a lecture, given some time ago, that every medical officer examining a recruit's teeth should use a dental mirror as, by so doing, extensive decay, especially between the teeth, is more easily discovered, and a number of discharges for dental reasons of men with less than six months' service might be avoided. I entirely agree with him. It is much easier to examine the teeth with a dental mirror than without one and, as it was stated in that lecture that a man who gets in the Army immediately costs the State a substantial sum, it is worth a few seconds more care in making the more thorough examination. The recruit should be brought into good light and the surfaces of all the teeth examined in order to ascertain their general condition. He should then be told to close his teeth, and the mirror should be inserted between the lips and the teeth and be carried back between the cheeks and the back teeth on each side, in order that the teeth in good apposition may be noted and their dental value assessed. I was glad this point was mentioned, as I had not realized that dental examinations were ever made without the use of a mirror.

Another point to which I would like to draw attention is that men are often sent to the dental officer by the medical officer with suggestions as to the line of treatment required. In most cases this is right, but sometimes it is not. For instance, a medical officer might suggest to a man that he

should have certain teeth out and wear a denture, but the dental officer might think that certain of the teeth could be restored and a denture avoided. The two opinions are apt to give the man a feeling of distrust. He may or may not accept the treatment prescribed by the dental officer, but whether he does or not it is not desirable that any difference of opinion should be apparent. I strongly urge, therefore, that the usual professional reticence be observed in these matters and that the man be simply instructed to see the dental officer.

In conclusion I would like to emphasize that our object as dental officers is simply to help to maintain the Army in a high state of effectiveness and to prevent any wastage which we have the means to avert. I am convinced that so far as our branch is concerned it can be summed up in four words, "preservation of natural teeth."

A COMMAND STAFF EXERCISE.

By Major W. EGAN, D.S.O.
Royal Army Medical Corps.

(*Continued from p.* 264.)

Remarks on Royal Army Medical Corps Order, No. 2.

(1) It is considered that you should have given more detailed orders to No. 4 Field Ambulance in reference to reserve of bearers and transport should casualties in large numbers occur during the advance. Have you represented to your G.O.C. the fact that your motor transport is completely put out of action by being located in the rear of the division?

(2) *Accommodation.*—This paragraph is badly worded and it is considered that a short para. to the effect that Field Ambulances will be billeted by their respective Brigade Commanders, would meet the case better.

(3) *Veterinary Arrangements.*—This is badly worded and if a notification is necessary in a Royal Army Medical Corps Order, a plain statement of fact is all that is necessary.

* * * *

(*Signed*) Directing Staff (Medical).

A.D.M.S., 2nd Division.

Situation No. 2.

Command Staff Exercises, June 10.

Requirement 2—as given on Programme of Work, p. 10 of papers issued for Command Staff Exercise, dated May 17, 1924.

Situation No. 2.

Time 11.00 *hours, June* 10.

Information from the Air.—The following shows the nature of the information available as the result of evening reconnaissances on June 9, and of those ordered by 1st Southland Corps and 1st and 2nd Southland Divisions, June 10:—

Continued railway activity on line Perth—Stirling—Edinburgh.

Continued detrainment of infantry and guns at Prestonpans; troops with transport also observed detraining at Longniddry and Drem, with subsequent road movement towards Haddington and East Linton.

Column of horsed transport moving east through Gladsmuir at 20.00 hours, June 9.

Artillery column leaving Edinburgh on Musselburgh Road at 19.50 hours, June 9.

About 05.30 hours enemy battery positions located about Cairdinnis (½ mile west of Traprainlaw), Old Hailes (½ mile north-west of Traprainlaw) and near cross roads 1 mile north-west of Whitelaw Hill.

There was no indication of the presence of enemy tanks.

Identifications.—These indicated the presence of battalions belonging to Northland 1st and 2nd Infantry Brigades, with machine gunners from 3rd Infantry Brigade.

Situation on 1st Division Front.—Tyne Bridge and East Linton road and railway bridges were destroyed by Northland at 10.30 hours, June 10, the Corps Cavalry and advanced guard of 1st Division having up to that time been delayed first by cavalry action and finally by a defence crystallizing on the line of the River Tyne, where strong rifle and machine-gun fire was encountered.

At 11.00 hours the advanced guard 1st Division was fully deployed on the general line, Tyne Bridge — Knowes — Phantassie — northern extremity of Spur running north-east from Traprain.

Two companies had just succeeded in gaining a foothold on the left bank of the River Tyne by the Ford, ¼ mile north-west of Knowes, but further progress here or on any part of the frontage did not appear possible. The left was unable to extend further owing to strong opposition from Traprain.

Advanced guard casualties approximately 150.

The head of the main body of the 1st Division was at Beltonford.

Situation on the 2nd Division Front.—The advanced guard of the 2nd Division, after meeting with considerable opposition along the line of the Whittinghame Water had succeeded in occupying the following line:—

B in Biel Grange—Grangemuir—second H in Whittinghame—Church ½ mile east of Whittinghame Mains.

All four battalions were deployed, one having crossed the water at Bielmill, two at the bridges near East Lodge and one by the bridges ¼ mile south of Whittinghame.

4th F.A. Brigade was in action close to the road running from south-west corner of Deer Park through Strenton to road junction two hundred yards north of second H in Whittinghame House. One section P.A. Batt. was in action near Biel Grange; one section near bridge three hundred yards south of N in Whittinghame.

The advance was definitely held up by a strong machine-gun and rifle fire from the localities of Sunnyside, Luggate, spur running east from Lawhead Plantation, and by field artillery fire from the direction of Traprainlaw. The troop of 1st Lancers found the river crossing near Papple strongly held.

Owing to difficulties of the route, No. 1 Column did not reach Pitcox

until 11.00 hours, at which time the head of No. 2 Column was at Little Spott.

Advanced guard casualties approximately three hundred.

Situation on 1st Cavalry Brigade Front.—1st Cavalry Brigade, which was opposed on the line White Castle—Dunskine by armoured cars, had by 11.00 hours succeeded, on the right, in taking the ridge in the vicinity of Garvald Grange in the face of determined opposition by infantry. Further advance on Whitelaw Hill was held up by machine-gun and rifle fire, but an attempt at movement against Lawhead Plantation—West Lodge locality was in progress.

On the left, Point 665 had been captured from Northland infantry, but heavy machine-gun fire was encountered from Townhead area, and enemy armoured cars were found to be in strength on the Dunskine—Baxtersike—Yester Mains road.

Casualties in 1st Cavalry Brigade approximately one hundred and fifty.

N.B.—Officers in carrying out the reconnaissances will not go beyond the line given for the advanced troops of Southland.

SECRET.
Copy No.—

1st CORPS ORDER No. 8.

Reference Map O.S. of Scotland. Sheets 33 *and* 34, *one inch to one mile.*

June 10, 1924.

(1) The enemy (strength estimated about one division with some cavalry and armoured cars) holding the line Tyne Bridge, River Tyne to East Linton—Traprainlaw—Whitelaw Hill—Gifford. Reinforcements are arriving from Edinburgh.

(2) Southland Corps will attack the enemy's forces east of Haddington and continue the advance on Edinburgh.

(3) (*a*) 1st Division will be directed on Garleton Hills, southern boundary Beltonford—East Linton Road (inclusive) thence River Tyne.

1st Objective.	*2nd Objective.*
Jane Field—Pengraig Wood.	Muirhouses—Abbeymains.

Final Objective.
Garleton Castle—Smallpox Hospital.

(*b*) 2nd Division will be directed on Haddington, northern boundary Beltonford—East Linton Road (exclusive) thence River Tyne. Southern boundary — Road Junction 491, one mile west of Garvald — Coulston Mains (inclusive).

1st Objective.	*2nd Objective.*
Cairnimis—Whitelaw Hills.	Stevens Mains—Woodend.

Final Objective.
Haddington—Parkend.

(*c*) 1st Cavalry Brigade will operate on the left flank of and conform to the attack of the 2nd Division directed on Pencaitland.

(*d*) 1st Tanks Battalion (less one company) will come under the orders of the 1st Division.

(*e*) 1st Army Field Artillery Brigade will be attached to 1st Division. The remainder of Corps Artillery will remain under the orders of the C.R.A. Corps Artillery.

(*f*) Anti-Aircraft. The Air Defences Commander will arrange for the protection of the divisional areas and to conform to the advance of the Corps.

(*g*) One flight each from 1st and 2nd Army Co-operation Squadrons will be detailed for counter battery work under the C.R.A. Southland Corps.

(*h*) Light Bridging Park and 2nd A.T. Company will march at 05.00 hours to Belhaven.

The advance will commence at 05.00 hours on the 11th inst. from the line—line Whitekirk—Tynebridge—Whittinghand. With this object in view the G.O.C. 1st Division will occupy the park of Tynninghame House before dark and arrange for the crossing of the River Tyne by tanks during the night.

1st A. T. Company will assist in the preparation of the necessary crossings under the orders of O.C. 1st Tank Battalion.

(5) *Corps Reserve* as under will be assembled at places stated by 05.00 hours.

Corps Cavalry Regiment }
Armoured Car Company } Tynefield.

2 Tank Battalion. North of Beltonford.

2 Battalions 4th Infantry Brigade. To remain in present positions until after advance of 2nd Division, and then to assemble at Ruchlaw Mains.

(*a*) Reports to Advance Corps Headquarters at Hedderwick from 05.00 hours.

(*b*) One D Set will remain allotted to 1st Cavalry Brigade.

(*c*) Communication laterally will be maintained by 1st Division to 2nd Division, and by 1st Cavalry Brigade to 2nd Division.

(*d*) Call signs and wave lengths will be changed at 02.00 hours on night June 10-11, and calls and wave lengths as in Appendix A will be taken into use.

Issued to Signals 16.30 hours. * * * *

Colonel,
General Staff, 1st Corps.

Copy No. 1. 1st Division.
2. 2nd Division.
3. 1st Lancers.
4. 1st Cavalry Brigade.
5. 1st Corps Artillery Com.
6. C.R.E. Corps R.E.
7. 1st A.A. Arty. Brigade.
8. 1st Tanks Corps.
9. 1st Armoured Car Coy.
10. Corps Signal Coy.
11. G.O.C.
12 & 13. G.
14 & 15. A. and Q.
16. Intelligence.
Copy No. 17. C.E.
18. C.S.O.
19. D.A.D. of Survey.
20. A.D. of T.
21. A.D. of S. and T.
22. D.D.M.S.
23. A.D.V.S.
24. D.A.D. postal.
25. A.P.M.
26. Camp Commandant.
27 & 28. War Diary.
29 & 30. File.
31. Headquarters, 1st wing, R.A.F.

SECRET.
Copy No.—

ADMINISTRATIVE INSTRUCTIONS TO ACCOMPANY 1ST CORPS ORDER No. 8.

Medical.—D.T. will arrange for the move of No. 2 C.C.S. from Burnmouth to Cockburnspath by rail to be completed by 19.00 to-day.

* * * *

D.A.A. and Q.M.G., 1st Corps.

Copies to all recipients of Southland Corps Order No. 8.

REMARKS ON ADMINISTRATIVE INSTRUCTIONS TO ACCOMPANY 1ST CORPS ORDER No. 8.

(1) Reference para. 4. Cockburnspath Station has no siding to take an ambulance train.

(2) The move of two casualty clearing stations from Burnmouth on June 10 would mean that no casualty clearing station would be open for the reception of casualties on that date. It is apparently not understood that it takes at least forty-eight hours to get a casualty clearing station going.

(*Signed*) DIRECTING STAFF (Medical).

R.A.M.C., ORDERS BY D.D.M.S., 1ST CORPS—*Nil.*

2ND DIVISIONAL ORDER No. 8. Copy No.—

Reference Map O.S. of Scotland, Sheet 33, *one inch to one mile.*

(1) The enemy is holding the line along the high ground, Traprainlaw —Whitelaw Hill--Gifford.

Southland is attacking with 1st Division directed Garleton Hills; 2nd Division on Haddington. Boundary between Divisions—River Tyne. Cavalry directed on Pencaitland.

(2) *Intention.*—2nd Division will capture the following objectives:—

(*a*) Cairndinnis—Whitelaw Hill.

(*b*) Stevenson Mains—Woodend.

(*c*) Haddington Park End.

(3) 5th Infantry Brigade will capture the line Nether Hailes—Cairndinnis Standing Stone Farm, and will be responsible for protection of its southern flank during the advance.

Zero hour 05.00 hours.

4th Infantry Brigade, less two Battalions in Corps Reserve, will attack Lawhead Plantation and Whitelaw Hill as soon as 5th Infantry Brigade reaches the line of the White Road Kippielaw—strip of wood at east edge of Traprainlaw.

C.R.A. will arrange that one F.A. Brigade and one Pack Battery are available to support this attack from 06.00 hours.

6th Infantry Brigade will pass through 5th Infantry Brigade on the capture of the 5th Infantry Brigade's objective and will capture the 2nd and final objectives of the Division.

Artillery.—The artillery will open at zero hour on definite points which will be communicated later.

The C.R.A. will arrange for smoke on the high ground Traprainlaw in accordance with the wishes of the 5th Infantry Brigade Commander.

Tanks.—"A" Company, 1st Tank Battalion, less 2 sections, will be at the disposal of 5th Infantry Brigade.

One section, "A" Company, 1st Tank Battalion, will be at the disposal of 4th Infantry Brigade.

One section, "A" Company, 1st Tank Battalion, will be in reserve and will later advance in support of 6th Infantry Brigade.

Medical.—An Advanced Dressing Station will be established.

Inter-communication.—Reports to Advanced Divisional Headquarters, Biel Grange, from 04.00 hours.

Acknowledge.

* * * *

Major, General Staff,
2nd Division.

Issued at 19.34 hours by Signals.

SECRET.
Copy No.—

ADMINISTRATIVE INSTRUCTIONS ISSUED WITH 2ND DIVISION ORDER No. 8.

Medical Arrangements.

(*a*) Main Dressing Station—Easter Broomhouse.

(*b*) Advanced Dressing Station at point 295 Stenton—Deer Park Road.

(*c*) Evacuation from A.D.S. to M.D.S. by Divisional Motor Ambulances.

(*d*) O.C. Divisional Train will detail two 30-cwt. lorries to report to O.C., A.D.S. at once to assist in moving walking wounded from A.D.S. to M.D.S.

* * * *

Major, A.A. and Q.M.G.,
2nd Division.

Issued at 19.00 hours to all recipients of Administrative Instructions issued with 2nd Division Order No. 7.

Message from A.D.M.S. 2nd Division, to O.C. No. 4 Field Ambulance at Spott.

Close M.D.S. immediately, leaving such personnel as you may consider necessary for care of casualties, which will be collected later under arrangements by O.C. 6th Field Ambulance AAA Move to Point 295 on road running north-east from Stenton and open an A.D.S. AAA As soon as casualties at Spott are cleared, your detached personnel will rejoin you by Ambulance Cars proceeding to A.D.S. AAA.

By D.R. Issued at 07.00 hours 10.6.24.

SECRET.
Copy No.—

R.A.M.C., 2ND DIVISION ORDER No. 8.

June 10, 1924.

Reference Map O.S. of Scotland, Sheet 33, one inch to one mile.

(1) The Advanced Guard now occupies the following line:—

B in Beil Grange—Grangemuir. Second H in Whittinghame—Church, half mile east of Whittinghame Mains. All four battalions were employed, one having crossed the water at Biel Mill, two near East Lodge and one half mile south of Whittinghame.

The advance has been definitely held up by steady M.G. and rifle fire from the localities of Sunnyside, Loggate Spur running east from Lawhead Plantation, and by F.A. fire from direction of Traprainlaw.

(2) The O.C. No. 6 Field Ambulance will establish an M.D.S. at Easter Broomhouse and be ready to receive casualties at 13.00 hours. He will arrange to clear the casualties remaining at Spott.

(3) O.C. No. 4 Field Ambulance will establish an A.D.S. at House quarter mile north-east of Stenton near Point 295, and will deal with casualties of the Advanced Guard. He will also arrange for the provisional accommodation for Gas Casualties and walking wounded. He will also establish a Car Loading Post and Relay Point fifty yards east of Road Junction north of Whittinghame House. If advance proceeds this post will take up its position at Point 442, three-quarters mile south-east of Papple. O.C. 4th Field Ambulance will later establish a Main Dressing

Station at Stenton. Officers Commanding Field Ambulances requiring R.E. services for the purpose of improving roads, turning points, etc., will liase with the Field Company Commander R.E. at nearest Brigade Headquarters.

(4) O.C. 2nd Sanitary Section will move to M.D.S. at Easter Broomhouse, and will come under orders of O.C. 6th F.A.

(5) No. 4 Field Ambulance (detached portion) will rejoin its unit at A.D.S.

(6) No. 5 Field Ambulance will conform to movements of 5th Infantry Brigade group.

(7) The ambulance cars of 4, 5, 6 F.A.'s will report at once to O.C. No. 4 F.A. at A.D.S.

(8) Sites for Dressing Stations as necessary will be immediately reported to A.D.M.S.

(9) Two lorries for walking wounded have been ordered by 2nd Division "Q" to report at A.D.S. at 14.00 hours.

(10) O.C.'s Nos. 5 and 6 Field Ambulances will supply on demand by O.C. No. 4 Field Ambulance such additional bearers as he considers necessary. Bearers so detailed by No. 5 Field Ambulance will rejoin their unit as soon as clearing is completed. Bearers from No. 6 Field Ambulance will remain at A.D.S.

(11) Under arrangements made by D.D.M.S. Corps a reserve of 100 stretchers and 200 blankets will be formed at M.D.S.

(12) Slightly wounded cases not requiring evacuation will be handed over to the D.A.P.M. for redirection to units.

(13) Motor Ambulance Routes:—

(1) M.D.S. to A.D.S.: Easter Broomhouse—Spott—Little Spott Pitcox—Stenton.

(2) A.D.S. to M.D.S.: Stenton—Pitcox—Belton House—Point 100—main Linton Cockburnspath Road to Point 74—Easter Broomhouse.

(14) Acknowledge.

A.D.M.S.,
2nd Division.

Issued at 11.00 hours.

Copies to:—4th Field Ambulance.	C.R.A.
5th ,, ,,	C.R.E.
6th ,, ,,	Train.
4th Infantry Brigade.	D.A.P.M.
5th ,, ,,	D.D.M.S.
6th ,, ,,	A.D.M.S., 1st Division.
"A."	War Diary.
"Q."	File.

Telegram.

To/ Train.

Q.5. 10.6.24.

Detail two lorries to report Advance Dressing Station at Point 295, Stenton—Deerpark Road, to clear walking wounded to Easter Broomhouse.

From 2nd Division.

Time of Origin 16.00 hours.

2ND DIVISION R.A.M.C. ORDER No. 9.

SECRET.
Copy No. —

June 10, 1924.

Reference Map O.S. Scotland, Sheet 33, *one inch to one mile.*

(1) *Information.*—Southland objective—Haddington.

1st Division on right flank towards Garleton Hills.

2nd Division on left flank towards Haddington, via (1) Cairndinnis—Whitelaw Hill, (2) Stevenson Mains—Woodend, (3) Haddington—Parkend.

Troops engaged, 5th Infantry Brigade on right and 4th Infantry Brigade (less two Battalions) on left. 6th Infantry Brigade will pass through 4th, 5th Infantry Brigades after these attain their objectives. Zero hour 05.00 hours.

(2) M.D.S. at Easter Broomhouse will be closed after 06.00 hours 11th June. O.C. No. 6 Field Ambulance will collect his bearers at Point 381, half mile south of Ruchlaw, at 07.30 hours and then conform to movements of 6th Infantry Brigade, establishing an A.D.S. at Coldale as soon as possible.

O.C. No. 4 Field Ambulance will send the temporarily attached bearers of No. 6 Field Ambulance to be at Point 381 at 07.30 hours.

(3) O.C. No. 5 Field Ambulance will form an A.D.S. as soon as possible near Gas Works on East Linton—Cockburnspath road.

(4) No. 2 Sanitary Section will proceed to join 4th Field Ambulance N.E. of Stenton (Point 295) as soon as M.D.S. at Easter Broomhouse is closed.

(5) At 06.00 hours, O.C. No. 4 Field Ambulance will expand A.D.S. to M.D.S. and will establish a centre for treatment of "Gas" casualties. Bearer companies of No. 4 Field Ambulance to conform to movements of the two attacking Battalions of the 2nd Infantry Brigade.

(6) Field Ambulance Commanders will effect liaison with the Field Company R.E. Commander for construction of Turning Points at Dressing Stations, Car Loading Posts, etc.

(7) Refilling Points—Supplies for consumption on 13th June—Wester Broomhouse at 02.30 hours on 12th June.

(8) *Transport.*—Meeting points for guides for baggage and supply lorries will be notified later.

(9) *Traffic.*—The Dunbar — Beltonford — East Linton Road from Dunbar to cross roads 300 west of 24th milestone will be closed to all traffic except Corps Artillery from 23.00 hours 10th to 01.00 hours 11th. Transport moving on the hill immediately south of Pitcox Smithy during daylight will only do so at intervals of 100 yards between vehicles.

(10) Reports to Advance Division H.Q. at Biel Grange from 04.00 hours 11th.

(11) Acknowledge.

Issued at 20.00 hours by D.R. A.D.M.S.

THIRD SITUATION.

Time 09·00 hours, June 11, 1924.

Information from the Air.—The essential items of information produced by the evening reconnaissances on June 10 include :—

(*a*) Continued detrainment of Infantry and Guns at Prestonpans and Eskbank.

(*b*) Indications of the occupation of the main ridge running south south-west from Tranent.

(*c*) Train movement from Perth, no unusual movement on the Aberdeen—Perth line.

The dawn reconnaissance, June 11, showed columns of H.T. and M.T. moving towards Edinburgh about Macmerry and Tranent.

Infantry columns about Gladsmuir Western Pentcaitland moving westwards.

Situation (General).—The attack went according to plan, meeting with little opposition except from M. guns and long-range artillery fire.

At 09.00 hours the 1st and 2nd Divisions were in process of launching their attacks on the final objectives as laid down in First Corps Order No. 8.

Situation on 1st Division Front.—Division on a two-Brigade front; leading Infantry on the general line the Chesters—Kilduff Mains—Amisfield Mains: rear Brigade having crossed the River Tyne in the vicinity of East Linton.

1st Division Artillery and 7th and 8th R.F.A. Brigades were in action, or moving into action in the area East Fortune Station—Markle—Athelstaneford Mains — Merryhatton, two H.Q. Battalions in action in the vicinity of Janefield, two Battalions on main road Dunbar—Edinburgh near 23rd milestone,

1st Tank Battalion (less one company), Newpyth.

2nd Battalion Tanks, Beltonford.

Corps Cavalry Regiment and Armoured Car Company in vicinity of Drem.

Situation on 2nd Division Front.—6th Infantry Brigade have just

captured the second objective—(Stevenson Mains—Woodend) and are advancing towards the final objective.

5th Infantry Brigade: one battalion Nether Hailes; one battalion Cairndinnis; two battalions immediately north of Traprainlaw.

4th Infantry Brigade: one battalion Lawhead Plantation; one battalion Whitelaw Hill, remaining two battalions in Corps Reserve at Ruchlaw Mains.

"A" Company 1st Tank Battalion: one section Coldale; two sections immediately east of Traprainlaw; one section Papple.

2nd P.A. Brigade (less one battalion) in action immediately north of Coldale.

6th F.A. Brigade in action in area Nether Hailes—Cairndinnis.

5th F.A. Brigade in area Sunnyside—Kippielaw.

4th F.A. Brigade and one P.A. Battery near Whittinghame Church.

2nd M.A. Brigade, two Batteries (T.D.) at Bieshill. Two Batteries (H.D.) marching between Grangemuir and Standingstone (half mile south of Traprainlaw).

Situation on 1st Cavalry Brigade Front.—2nd and 3rd Regiments on line Bolton—East Salton. 1st Regiment Stone Cross.

Position of Chief Administrative Units at 05.00 *hours, June* 11.

1st Division M.T. Company (Supply Section) } Innerwick Station.
2nd Division " " " }

Corps Troops M.T. Company, Reston.

1st Cavalry Brigade M.T. Company, Chirnside.

(*To be continued.*)

OBSERVATIONS ON THE GROWTH OF MENINGOCOCCI *IN VITRO* IN RELATION TO VIRULENCE.[1]

A REPORT TO THE MEDICAL RESEARCH COUNCIL ON WORK CARRIED OUT AT THE UNIVERSITY OF CAMBRIDGE PATHOLOGICAL LABORATORY AND FIELD LABORATORIES.

BY E. G. D. MURRAY AND R. AYRTON.

(*Continued from page* 273.)

(*h*) *The Accessory Growth Factors.*

It is well known that in primary culture the meningococcus requires these accessory substances and probably this is the principal reason why it is universally understood that special media are necessary to grow it. The absolute need for special provision of these accessory factors decreases with the time a given strain has been kept in culture and the meningococcus can readily be educated to grow on "ordinary media," as is a common practice in laboratories. But two outstanding features of the life of this organism *in vitro* definitely prevents any application of this practice to the work we are doing at present: firstly, freshly isolated strains or those which have been raised in virulence will not grow readily on ordinary media; and, secondly, the repeated subculture necessary to accustom the organism to such media immediately deprives the cultures of their power to kill mice. Thus it is essential, apart from any other properties the medium may possess, to provide the required accessory growth factors.

It is not our purpose to consider these substances with any intention to classify them, but the manner in which we used the fluids containing them falls naturally into two categories:—

(1) Their addition to the medium immediately before use and after sterilization.

(2) Their addition as an integral part of the preparation of the medium before sterilization.

The first method requires that the substances be added to the otherwise finished medium with strict sterile precautions and at the same time exercising minute supervision over other conditions, in order that the supposedly delicate accessory growth factors are not subjected to treatment which either destroys or removes them: such as autoclaving or adsorption by large surfaces provided by filter paper or finely divided precipitates. The second method allows of the accessory growth substances, in the presence of the other constituents of the medium, to be subjected to the usual processes of sterilization, filtration, etc., without interfering with their function. Obviously this has great advantages.

The substances we have tried by the first method are: ascites fluid horse serum, laked horse blood, formol serum and extracts of red corpuscles. The substances we have tried by the second method are: Gordon's extract of pea-flour, freshly drawn horse blood, extracts of red corpuscles, formol serum and our own method of using extracts of heart muscle.

So much for the categoric treatment of the subject, and we shall now consider each of the individual substances by their effect upon growth.

Ascites fluid, when freshly drawn and added immediately before use to agar media which have been cooled to 45° C., is undoubtedly superior to any other substance we have tried. In our experience it enables media which are otherwise absolutely unsuitable for meningococcal growth to give a remarkable yield per unit area. Nevertheless, in addition to the difficulty of maintaining an adequate supply and contrary to the invariable statement of the case, ascites fluid does not keep well exposed to the air in vessels plugged with wool. We have not tried hermetically sealed vessels. Using the same batch of medium, or batches made as nearly alike as we know how, to which was added 5 per cent of ascites fluid immediately before pouring the plates, we obtained profuse, smooth, creamy growth when the fluid was freshly drawn. As the fluid aged (ten days) the growth tended to become sticky, until at last it became unmanageable, reaching such a degree of stickiness that it could not be removed from the surface of the agar (thirty days). As the sliminess of the growth increased the yield appeared to become less. We were inclined, at first, to blame every process and ingredient used in making the medium except the ascites fluid, and we spent a considerable time investigating the effect of various alterations, without improving matters until we examined the ascites fluid. Ascites fluid which had been kept in vaccine bottles with wool plugs for thirty days was very alkaline, well beyond pH 8·0: when it was fifty days old, five cubic centimetres of it required 0·7 cubic centimetre $N/10$ HCl to adjust its reaction to pH 7·2, in spite of the fact that the fluid appears to be comparatively slightly buffered. When the reaction of five cubic centimetres of this fluid containing phenol red was adjusted to pH 7·2 and left standing in a boro-silicate glass tube for fifteen hours exposed to the air, the upper layer of the fluid became very much more alkaline than the lower layer.

A hundred cubic centimetres of ascites fluid were placed in a wool-plugged flask and the reaction was adjusted to pH 7·2 with full sterile precautions; it was then left in a cool dark cupboard for six days, when the reaction was found to be pH 8·0 and five cubic centimetres required 0·3 cubic centimetre $N/10$ HCl to restore the reaction to pH 7·2. Every precaution was taken to reduce the absorption of alkali from the glass. Two litres of the same fluid were stored in the cupboard in a Winchester quart bottle with a rubber bung and only exposed to the air through a piece of glass tubing of four millimetres diameter tightly plugged with wool; after fifty days it was more acid than pH 6·6 and 5 cubic centimetres

required 0·2 cubic centimetre $N/10$ NaOH to adjust its reaction to pH 7·2.

The growth obtained on good media when 5 per cent. of the fluid which had become alkaline was added, was too sticky to remove from the surface of the agar; neutralization of the fluid (to pH 7·2) before using it gave smooth creamy growth once more.

It appears, therefore, that exposure to the air quite rapidly causes a change in ascites fluid, which renders it more than ordinarily difficult to use and for that reason we abandoned it.

Horse Serum and Laked Horse Blood.—The serum was obtained in the ordinary way by allowing sterile blood to clot. The laked blood was obtained by drawing horse blood into an equal volume of sterile distilled water; it hæmolyzed immediately, subsequently a clot separated and the hæmoglobin-stained serum was used to supply the accessory growth factors. Both these substances were added to the medium immediately before use in quantities varying between one and five per cent and they stimulated growth nearly, but not quite, as well as human ascites fluid.

We discontinued their use because they exhibited a similar change to that described in ascites fluid and with the same effect, without presenting any other property of particular advantage.

Formol Serum was prepared as described by Nicolle, Debains and Jouan (1918). Legroux (1920), used horse serum. It was added to our media immediately before use in the quantity directed and our results were less satisfactory than those obtained with ordinary serum or laked blood. This substance also became alkaline when exposed to air and again after neutralizing.

It is a curious fact that formol serum prepared as directed does not clot when autoclaved, it becomes more opalescent and a smell of H_2S is evolved; and that whole serum to which two per cent of formalin has been added does not coagulate when heated at 100° C., or even when boiled, but when added to medium containing two per cent of agar and our usual salts coagulation takes place on steaming or autoclaving.

Extracts of Red Corpuscles, prepared in the manner described by Agulhon and Legroux (1918), Legroux and Mesnard (1920), when added to media immediately before use gave results slightly inferior to those yielded by our ordinary media, to which the accessory growth factors were added before sterilization. The only remark we have to add is that the addition of the extract before autoclaving only slightly reduced its efficiency. These extracts were designed to replace fresh blood in media on which it was required to grow Pfeiffer's bacillus.

Gordon's Extract of Pea-flour was used in preparing "Trypagar" as described by Gordon, Hine and Flack (1916). We did attempt a few experiments in which this extract was added to our media, but with little success as the results were always inferior to our standard method.

When this substance was used by Gordon and others, when the medium

was supplied on a large scale during the epidemic of cerebro-spinal fever in the British Army, it was always accompanied by horse serum or laked rabbit blood, to be added to the medium before use. This fact made us less interested in it than we would have been had it unfailingly grown the meningococcus in primary culture without the additional substances.

Freshly drawn Horse Blood.—The addition of fresh blood to media is a well-established method of promoting the growth of delicate organisms and it is usual either to add it to the melted and cooled medium, or to smear the surface with blood, but each method suffers from inconveniences we wish to avoid. The coagulation of blood in the medium by heat has had its advocates. While certain of them are content with an opaqne medium rather resembling a slab of chocolate, others have removed the coagulated protein by specialized methods with the idea of retaining the accessory growth factors, which otherwise, they claim, are destroyed or removed (Lloyd, 1916). The method we advocate, which has given results only surpassed by *freshly drawn* ascites fluid, and perhaps the method we shall presently describe, depends upon the coagulation of fresh blood in the presence of agar and the subsequent removal of the clot, without interfering with the accessory growth factors required by the meningococcus in any degree we can detect. At the same time the method has this advantage, that no elaborate nor troublesome technique is required either for the removal of the coagulum or the sterilization of the finished medium. When all the ingredients of the medium have been added and the melted agar has been cooled to 50°—55° C., seven per cent of freshly-drawn horse blood is added, with stirring to make a homogeneous mixture, which is then gradually raised to 100° C. in the steamer. By keeping it at this temperature for thirty minutes a considerable shrinkage of the coagulum is produced. The agar is then allowed to cool and set and so is *left overnight.* We consider it to be important to let the agar set in the presence of the coagulated blood, as we have tried on many occasions the effect of removing the coagulum immediately after heating at 100° C. and without preliminary setting of the agar, but the result has always been most unsatisfactory. It is possible that the alteration of the physical state of the agar during setting plays some part in the process. The next morning the agar is melted, decanted off from the coagulum which will have contracted further and strained through surgical lint in a hot-water funnel; finally the clot is tipped into the filter and after draining the remaining medium is gently wrung out by twisting up the lint. After the reaction of the filtrate has been adjusted to *p*H 7·2, it is distributed as required and sterilized in the autoclave at 120° C. for twenty minutes. The resulting medium is glass clear, although there may be a small flocculent deposit which rapidly settles out, and the virulent meningococcus grows readily in primary culture. The removal of the coagulum is facilitated by carrying out the process in straight-sided enamelled pails, within which are placed closely fitting muslin bags, held in position by strips of cane. When coagulation has taken place the

strips of cane are removed and the bag is gently drawn to one side; the bag holds back the clot while the medium is decanted, and eventually, after draining, the bag and contained clot are wrung out into the lint filter.

We wish to comment on a few points arising out of this method:—

The quantity of blood used is the maximum which we found gave us a manageable coagulum; greater quantities were inconvenient and did not seem to possess any advantage. Better results seem to have been obtained when the reaction of the medium in which the blood was coagulated had been adjusted to pH 7·0—7·2, rather than when it was definitely acid or alkaline.

We tried various methods of separating the coagulum, such as filtration through glass wool, paper and lint, also simple decantation, but we were unable to detect any difference in the growing power of the product. Filtration through lint possesses the great advantage of being a rapid process with very little loss of material.

Sterilization by steaming at 100° C. on three successive days showed no advantage over autoclaving. In fact we find that this medium stands several autoclavings on different occasions at 120° C. for twenty minutes, without appearing to change in any way other than becoming clearer.

In the course of our work it has frequently been necessary to make a series of media, in small amounts, in which some one constituent varied. This was greatly simplified by the fact that the coagulation of blood in a solution of agar in extract, with the subsequent addition of the other constituents, was quite as effective as coagulating the blood in the otherwise finished medium.

We call this form of medium "*EB* agar" (Extract, Blood) and "*EDB* agar" when the digest has been added.

Fresh Heart Muscle.—Under certain conditions it is difficult to get a sufficient quantity of freshly drawn blood to make large amounts of medium in the manner described, and it occurred to us to try to use the heart muscle from which we make our extract and digest. But before proceeding we wish to repeat that we only use freshly killed meat.

Attention has already been drawn to the copious coagulum we observed in making our ordinary extract, when it was raised to 100° C., but we wish now to emphasize another closely related point. When the meat has been extracted at 70° to 75° C. for three hours the fluid is a rich tawny red colour, which changes when heated at 100° C. to a pinkish yellow, with the separation of the coagulum and on autoclaving a further change of colour to a bright yellow takes place, with the separation of a fine whitish precipitate. At each stage the fluid has a bright, crystal-clear appearance.

We therefore filter the extract immediately after its three hours at 70 to 75° C., in the manner described under the method of making the extract, and into this filtrate we stir an equal volume of a 4 per cent solution of agar in ordinary extract cooled to 70° C. The whole is then raised to 100° C. and treated strictly in the manner described for coagulating blood in the

medium, with the exception that the muslin bags are dispensed with because there is not so much coagulum to remove. The resulting filtrate is not so clear as when blood has been used but its transparency can be much improved by entangling the fine coagulum in a precipitate of phosphates, as described under methods of clearing medium. But we find it advisable not to clear the medium thoroughly as definitely better results are obtained when it is slightly cloudy.

This preparation, which we call "*EH* agar," forms the basis of our medium and it keeps well stored in this form after autoclaving. To it we add the desired quantities of digests and salts and adjust the reaction, to make the finished medium which we speak of as "*EHD* agar" (Extract, Heart, Digest). This medium is no whit inferior to "*EDB* agar," in fact we are rather inclined to judge it as better. The accessory growth factors in this form are resistant to autoclaving and we strongly recommend the method for making media for general purposes.

It is best to avoid autoclaving "*EH* agar" more frequently than is absolutely necessary as the finely suspended matter tends to agglomerate and settle out as a reddish deposit, leaving the agar perfectly clear and the growth obtained on this very transparent medium is erratic and in the case of highly virulent strains it may be uncertain. In this respect "*EHD* agar" differs from "*EDB* agar," which is unaffected by thorough filtration or the clearing effect of repeated autoclaving.

If, however, the deposit is added to part of a plate of perfectly clear "*EHD* agar," satisfactory growth occurs on that part of the surface overlying the deposit; and if the fine precipitate is evenly distributed through the medium before use, perfectly satisfactory growth is obtained over the whole surface. For this reason we are content at present with the slightly cloudy medium obtained by filtration through lint and do not clear it by means of the phosphate precipitate or any other method.

(*To be continued.*)

A CORRESPONDENCE CIRCLE.

By Major M. B. H. RITCHIE, D.S.O.
Royal Army Medical Corps.

V.

The Medical Attendance on Military Families—Should it be Paid for?

The usual attitude of most of us towards medical attendance on families of officers and other ranks is that we do not seek after this branch of our duties, but we carry it out to the best of our abilities when it falls to our lot. (I am leaving the specialist out of the question.) Being outside the scope of military medicine, we are apt to treat medical charge of families as a side-show and perhaps underrate its importance. Yet there are several points about it that we should not forget, as it is capable of being exploited to our advantage; the credit of our Corps may be enhanced or diminished according to the manner in which this duty is carried out.

It is possible that the wives of both officers and soldiers have been tardier than their husbands in admitting the advance which has been made by the medical services of the Army during the last quarter of a century. Though the majority is favourably disposed towards us, there is a small minority, from ignorance or prejudice, that does not share wholly this good opinion. It is my belief that much of the hostility that the medical service experienced in former days came not from the officer, but from his wife; even as regards military rank, her attitude was invariably die-hard. With all its charm, the fair sex is distinctly conservative in outlook.

On our part, in our attendance upon them we are handicapped. Our advice and our medicines are given gratis; being paid a fixed salary independent of the number of cases we attend, we can afford to be candid; we need not prescribe useless physic merely to impress our patients; when called out unnecessarily at night we may experience difficulty in concealing signs of faint displeasure; and we are placed in charge of them whether they happen to like us personally or not.

Human nature, invariably present, frequently overlooked, places us at a distinct disadvantage in comparison with the private practitioner. When called out at night to see a trifling case, he is full of good cheer and goes back to bed at once with double fees in his pocket; the patients will follow rigidly the advice which has been paid for, and ignore that which was gratuitous; the same with medicines; and the fact that one medical officer has been placed officially in charge of families appears to awaken the desire to call in another.

The ideal to be aimed at is that the families should come to us voluntarily, feeling that from us they will get the best advice and treatment available. This is already the case with most, but it should be with all, and in every station. Further, our professional influence would be greatly enhanced if our advice and attendance were paid for. The service would gain, as the families would then pay more regard to our opinions. *Payment of a medical adviser is one of the psychological factors of effective treatment.*

The fee need not be large, and it should be commensurate with ability to pay, according to the emoluments of the husband, increased for night visits. Also, families might be permitted to call in any medical officer they wish, if he is prepared to attend them, so that the relation of families to the Royal Army Medical Corps would approximate that of civilians to the local members of the profession. If this could be done, it is probable that our good name as a Corps would be enhanced considerably. It would be interesting to have expressions of opinion on this subject from readers of this Journal.

There is another point in connexion with medical charge of families that does not appear to have been realized fully, and that is the wide professional field that this branch of our work affords. Unpopular with many, is not our outlook upon it somewhat inclined to be narrow?

All of us are fond of children; they are interesting patients and the diagnosis of their complaints frequently calls for more investigation than those of adults; they tend to sharpen up the clinical sense; as the child is the father of the man, so the physician skilled in children's diseases is skilled also with the adult; to him who contemplates private practice, the families are the best training ground that the Army affords; it is a good channel for advancement, as the public and the powers that be are apt to judge on the "good doctor" standard, and a senior officer in the field is not likely to forget a medical man who has shown professional ability and gained the confidence of military families in peace. The medical officer with a first-class professional reputation occupies a very strong position, one that is held only with greater difficulty by the administrator; good doctoring leads the way in peace time. It would be interesting to frame an unofficial policy with regard to this branch of our work, based on the opinions of individual officers.

Some Pros and Cons of Chemical Warfare.

I.

One hears and reads so much about the awful possibilities of chemical warfare that one is tempted to consider the subject in the light of the limited knowledge of it that one possesses, and to speculate whether after all it is a real "big noise" of the next war, or whether it may not be found wanting in effectiveness when it comes to be weighed in the balance,

and superseded by some other method of destruction. The following does not represent a personal view; it is a basis for discussion and not a considered opinion, so it would be interesting and instructive if those who are conversant with the chemical warfare situation to-day would be good enough to tear it to pieces.

II.

The impressions of chemical warfare held by the average man are derived chiefly from articles in the Press. He thinks of the subject as poison gas, which, I presume, is but a part of chemical warfare. So let us consider gas only. In these articles the possibilities of new and unexpected gases are enlarged upon, and one is led to believe that gases of all sorts can be discovered with comparative ease by chemists, and exploited in those countries that possess in their dye industries the means of manufacture and the apparatus required for rapid production on the outbreak of war.

III.

Against this view is the impression that most of the gases used in the late war were already known to chemists many years ago, and that it was the war value of these substances that was discovered after 1914. Much hectic investigation must have been done by the belligerents prior to the armistice, and if nothing new was then found the chances of lighting upon a brand-new chemical may not be quite so great as one would suppose. Also, if a lethal gas is discovered, there are questions of ease and cost of production that have to be taken into account. It is not enough for a substance to be lethal, as it must fulfil other conditions as well. And its nature must be kept a profound secret for many years, a difficult matter if rivals should employ well-paid agents.

IV.

This brings one, in one's ignorance, to speculate whether chemical warfare may not have limits set to its progress until such time as it can move forward to the employment of new weapons. Surprise is one of the great assets of chemical warfare. Dealing with a vast subject like chemistry dogmatism is impossible, and though nothing might be found for several years a dozen useful chemicals might come to light in a few days. But the finding of them is not quite so simple as articles in the Press lead us to believe.

V.

The main argument against gas, however, is to be found in the statistics which anyone may peruse in the "Medical History of the War—Diseases of the War (Vol. II)." (In passing it may be said that this book contains

the best material available for the study of the medical aspects of chemical warfare.) The total casualties from enemy gas attacks on the British front were under 181,000, of whom 6,062 died. Among pensioners after the war the average degree of disability was about twenty per cent. Its low mortality is brought out by the fact that in the 4,351 deaths from all causes that occurred among pensioners in six years, from the beginning of the war up to a date in 1920, an examination of the records of these cases showed a history of even moderately severe gassing in only ten cases. With mustard-gas poisoning seventy-five per cent of casualties can be returned to duty in less than eight weeks, involving only a short period in which they require special nursing. I think it is time that the general public got gas poisoning in the late war into its proper perspective, whatever it may be in the future.

VI.

As a casualty-producer, then, gas does not seem to have been nearly so effective as many diseases of comparatively low incidence. Apart from the first gas attack at Ypres, and the first experience of mustard gas, there is much to support the view that gas is more humane than explosives, and it is a weapon that disables temporarily more than it kills. That is of course the gas that we experienced in the late war. Gas shells *versus* high explosives—would the Germans have gained better results if they had flung high explosives at us instead of gas shells? Did gas "pay"?

VII.

So much for a case against gas. Let us hope that we shall hear the other side of the question. For instance, it is not enough to judge by British experience; we would require to examine the French, German, and American statistics before a true estimate can be made. Gas most assuredly "paid" at Ypres in 1915, and in the first mustard gas attack; this indicates the importance of surprise in chemical warfare, and stresses the need for the new and unexpected. But the gases of the last war have still to be reckoned with, and we must get rid of the common impression that chemical warfare has advanced so far as to render our late experiences useless. It is idle to suppose that an effective weapon like mustard gas is obsolete, so perhaps we should go on steadily and develop our ideas regarding prevention and treatment. These require our serious attention, and we should do well to consider the big problem of combating mustard gas casualties well up in the forward area, as this requires very elaborate de-gassing arrangements, most of which will fall to our lot if an enemy employs mustard gas against the British Army in some future struggle. The training and teaching of 1918 are by no means obsolete.

VIII.

The point that may ensure permanency for chemical weapons is that they can place large numbers of hostile troops out of action for some time, suddenly and unexpectedly, at a vital part of the front; as reinforcements arrive they may in turn be put out of the battle; and an army that can advance untouched through the gas zone that it has created may have an easy task in attaining victory. Also, an army that has to take precautionary measures against chemical weapons loses in mobility and hitting power. Chemical warfare is thus a perpetual nightmare to the high command. *It is a perpetual nightmare to the medical service also.*

"OVERCAME SOLDIERS ACCUSTOMED ONLY TO THE USAGES OF THE PAST."[1]

II.

"GAS" (CHEMICAL WARFARE) DEFENCE AND THE HEALTH SERVICE.[2]

By Major H. S. BLACKMORE, O.B.E.[3]
Royal Army Medical Corps.

On consideration, our subject divides itself into two possible situations:

(1) When a special chemical warfare service is organized;

(2) When it is not,

but we must keep our eyes resolutely turned from the contemplation of the past. The past provides us with concrete cases, pegs on which to hang our thoughts, and definite facts to guide us in evolving our plans, and is, therefore, very attractive to the ultra-conservative, the unimaginative, and the mentally lazy, but by itself it is a snare and a delusion. The rapid advance of aerial warfare, the evolution of mechanicalization, and the potentialities of chemical warfare, combine to make it essential that we leave the comparatively easy anchorage of "the past," and face the fact that, in the main, our conceptions of war must change. If we are to avoid the pitfalls into which the opponents of Napoleon fell by focusing their minds upon the out-of-date methods of Frederick the Great, we must substitute imagination and foresight for retrospective, and comparatively effortless, browsing.

I.—When a Special Chemical Warfare Service is Organized.

The organization of a special chemical warfare service, with a permanent cadre, must come. This is not an inspired prophecy, but the logical conclusion at which all will arrive who trouble to study the situation, and the arguments in favour of this conclusion are quite brief and simple.

History shows that no weapon of war which has proved its power and practical utility has ever been discarded, more especially when such weapon has the additional advantages of being comparatively cheap, and of fitting naturally into the trend of the contemporary evolution of war (in this case aerial and mechanical). Chemical warfare has the further

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[1] A quotation from W. Morris's "Napoleon," p. 205.

[2] As this article is the second of a series, the title of "Health" in lieu of "Medical," suggested in No. I, is retained for the sake of the sequence of thought.

[3] As I am at present doing duty at the Chemical Warfare Experimental Station, Porton, I wish to avoid the possibility of misunderstanding and to state definitely that the views expressed in this paper are my own personal views, and are in no way either "official" or "inspired."

advantages, as pointed out by Colonel Fuller, R.E., in his book "The Reformation of War," of being able to produce large numbers of casualties with a very low death or permanent injury rate, and having great inherent possibilities of surprise.

We, as one of the signatories at the Washington Conference, are bound, as a nation, by that agreement, but, in the writer's opinion, chemical warfare has come to stay. If this is accepted as a fact, one passes naturally to consider what is chemical warfare's actual importance. Some indication of its potentialities may be gathered from a perusal of the "Official History of the War" ("Medical Services, Diseases of the War," Vol. II), but one must remember that the whole subject was new, and that the proper strategical and tactical principles of employment of the weapon were not fully understood: that it was never used from what is, perhaps, its best point of employment—the air: and that the possibilities of mechanicalization had been only vaguely glimpsed "as through a glass darkly." The magnitude of its effect when used against a force whose anti-gas discipline or equipment is of a low standard, may be gauged from a Russian débâcle in 1916, when casualties totalling 200 officers and 25,000 rank and file were produced by three bursts of gas, from cylinders, of about seven minutes each, some twenty minutes in all, at an approximate cost of sixpence per head! To mention this latter fact appears rather brutal, but war is brutal, and extremely practical, and a weapon which is capable of producing such results at so little cost to the nation is obviously one which has, in this very potentiality, the strongest claim to consideration so long as war shall remain.

But there are other sides to this weapon, such as "smoke," and all that the term includes of protection for our own troops and the harassing of the enemy's by the induction and fostering of the element of uncertainty.

May I be permitted here to register a plea for the abolition of the old term "gas," and the substitution of the more accurate one "chemical"? It is always a pity to allow looseness of nomenclature in official language, for it inevitably leads to inaccuracy of thought on the part of those who are in a position to know better, and to a whole mass of misconceptions and misunderstandings in the minds of those whose knowledge is not sufficient to enable them to correct for themselves the erroneous ideas thus gratuitously started.

To epitomize then, we may say that chemical warfare has come to stay: that its importance and potentialities are steadily increasing, it being peculiarly in sympathy with the trend of modern military development: and that the past has shown that even under the then far less favourable conditions its power was very great. Suppose then that the instituting, sooner or later, of a special chemical warfare service with a permanent cadre be an accepted fact, what would be the place of the health service?

I think I am correct in saying that there is a definite feeling that the place of the health service would be that of an accessory after the fact.

By this I mean that its ròle would be to treat the cases when they occur, and that its activities would be officially limited to this rôle, with some secondary and occasional duties devolving upon it in emergency, such as the use of its so-called " Sanitary Sections " as deterging agencies.

This is all quite a natural result of the rôle played by this service through the past, and of having a retrospective outlook, but is it logical, and is it the best conceivable for the Army as a whole? To answer these questions one must obtain a clear mental picture of the general trend of chemical warfare problems, which can be broadly divided under headings as follows :—

(1) The discovery of substances, and the evolving of practical methods for their employment in the field.

(2) The study of strategy and tactics, both offensive and defensive.

(3) The evolution of protection, either individual or communal or both.

(4) Treatment of casualties.

We will now consider in what way and to what extent the health service is concerned with each of the divisions.

(1) *The Discovery of Substances and the Evolving of Practical Methods for their Employment in the Field.*

At first sight this would appear to be entirely a question for the chemical and physical, in conjunction with the technical experts of the chemical warfare service. But is this, in fact, the case? It is not. There are vital physiological questions to be considered. Substances betray little or no evidence of their mode of action, their potentialities, or of the concentration at which they will produce their effect in their chemical formula or their physical state, these are questions for the health service experts. Other considerations falling into the same category are questions of persistency in effective strength, or the reverse, under various atmospheric and climatic conditions, storage, etc., all questions which must be the province of the health service.

(2) *The Study of Strategy and Tactics, both Offensive and Defensive.*

In this matter the health service is obviously directly interested, as upon it depends the development of its own particular strategy and tactics, and the evolution of its units to fit in with the same: the training of its officers and other ranks to grasp and to cope with the new conditions : and the acquiring by its members of sufficient understanding to enable them to add their quota of considered thought to the advancement of the new weapon and the study of its problems.

(3) *The Evolution of Protection, either Individual or Communal or Both.*

Here again, the co-operation of the chemical, physical and health experts, is required for the discovery and perfection of ways and means, as in paragraph 1. This time, however, it is the health service which is the

prime factor, whether it be through the experts who evolve the methods, or in the collation and co-ordination of the multifarious details involved in the application of these methods which range from the physiology and psychology of the respirator to the removal of mustard gas from contaminated articles in a base depot. The foundation for this claim is to be found in the fact that this service is fundamentally concerned in all questions of health and must have the lead, the control and the executive power in dealing with these matters if the best results are to be obtained . . . a theme elaborated in a previous paper of this series. Neither by putting the cart before the horse, nor by divorcing the one from the other, is the most satisfactory progress made.

(4) *Treatment of Casualties.*

This section requires no explanation, it is the unchallenged province of the health service though help will be needed from the expert chemists and physicists.

One is now in a position to review the question of the part that should be played by the health service in the event of the institution of a special chemical warfare service.

A consideration of the foregoing paragraphs will make it evident that the health service is directly interested in all the various branches of activity of chemical warfare.

That its interest is of considerable importance in all and of paramount importance in some.

That if the best results are to be obtained its rôle must be a very different one from that mentioned as being tentatively allocated to it at present.

But if it is to occupy its logically correct position it must do so with untrammelled hands. It must have full recognition as an executive branch, co-equal in theory with the other branches (whatever it may be decided they should be), so that its full potentialities may develop. In such a position its actual relative importance in any given situation would naturally be decided mechanically by the general and particular trend of the matter concerned, as is the case with all such theoretically co-equal branches, whilst it would be free of the constant irritation, and ever present handicap to efficiency and zeal, of responsibility without commensurate executive authority. Under its hand would be co-ordinated the many variants of activities which are its natural province, and the curious anomalies extant in its present organization would be avoided, with the improved results that proper co-ordination must bring.

My conclusion then is, that in a chemical warfare service so constituted as to produce the best results, the health service would have a definite autonomous place co-equal with the other branches, and that it must have full executive powers if it is to "pull its weight," with the usual and

natural unwritten proviso that the branches must practise give-and-take towards each other according to the general and particular trend of any given specific problem.

II.—When no Special Chemical Warfare Service is Organized.

The second situation suggested for consideration was when no special chemical warfare service had been organized. The position is in no way altered except that the relative importance of the health service is greatly increased, and with it the desirability of the suggested reforms in its organization. In the absence of a special service almost the whole weight of chemical warfare problems will be thrown upon the shoulders of the health service, as was the case in 1915, and unless the reforms in its status have been adopted those shoulders will still be handicapped and trammelled, as they then were, by the want of autonomy and executive authority. To say that it then rose adequately to the demands made upon it is no argument against the removal of the difficulties under which it worked, but just a compliment to the individuals who successfully answered the call in spite of a self-evidently anomalous organization.

It must be clearly understood that the foregoing remarks are founded upon the realization that the new weapon demands new methods. Many of the conclusions arrived at would be unwarranted if there was to be a slavish adherence to the belief that "as things have been in the past so will they be in the future." The fallacy and danger of this attitude of mind is illustrated by history, and it must be the earnest desire of all thinking individuals to avoid the disasters which befell Napoleon's adversaries when he "overcame soldiers accustomed only to the usages of the past."

(To be continued.)

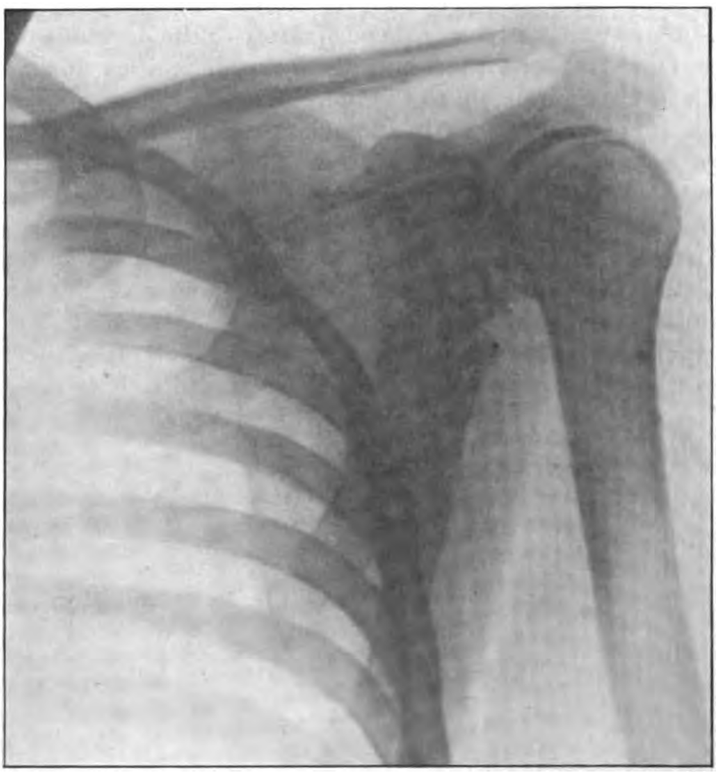
Clinical and other Notes.

TWO UNUSUAL FRACTURES.

By Major A. G. WELLS, D.S.O.
Royal Army Medical Corps.

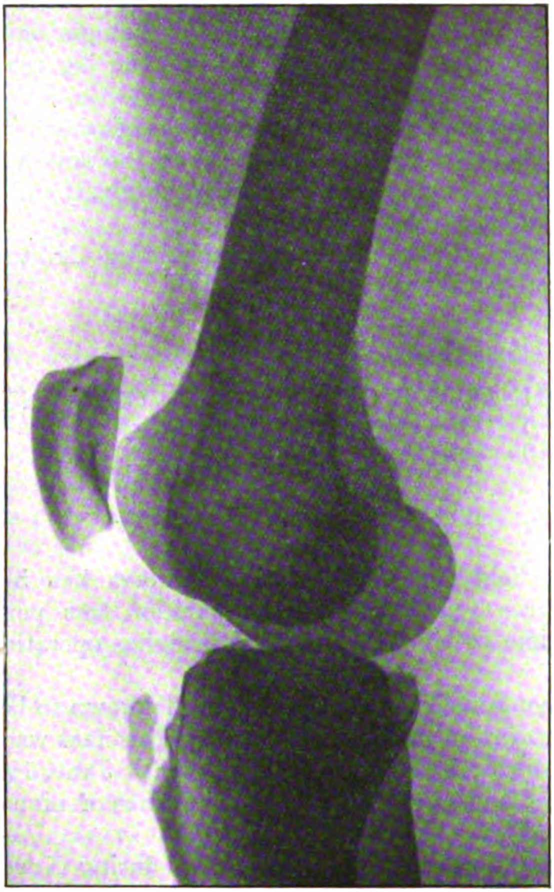
The two fractures which are here described are of such rare occurrence that they seem worthy of publication.

Case 1.—Private G. was admitted to the Military Hospital, Shorncliffe, November 29, 1924, with the following history :—



Whilst at fire practice he was pulling the fire engine at a run through a gate, the men behind failed to stop the way on the engine and he was crushed between the vehicle and the gate post. On examination the left shoulder and back were intensely painful, swollen and bruised. Even so, there was evidence of some flattening of the shoulder with prominence of the acromion process. The arm supported in a sling could not be moved

by the patient, but during examination any movements, especially abduction, produced crepitus over the shoulder-joint. Fracture of the scapula was suspected and the patient sent to the X-ray department. The skiagram revealed a fracture through the surgical neck of the scapula extending from the suprascapular notch to just below the origin of the triceps muscle. The fragment which therefore included the coracoid process was displayed downwards and forwards. Under anæsthesia, pressure



upwards in the axilla was made and maintained by a firm pad of wool. The upper arm was bandaged to the side and the elbow supported in a sling. Three days' treatment with evaporating lotion, to relieve the swelling and ecchymosis, was followed by massage and passive movements. He is now convalescent and can use the arm sufficiently to feed himself.

Case 2.—Gunner H. was admitted to hospital on December 21, 1924, with a history that, whilst playing football the previous day, he took a

running kick at the ball but missed it. He is not sure whether his foot struck the ground or not. He had a severe pain in the knee and was unable to continue playing.

On examination there was considerable swelling around the knee and great pain and tenderness over the tubercle of the tibia. The tubercle could be felt freely movable and was displaced somewhat upwards. A radiogram confirmed the diagnosis of fracture of the tubercle. The leg was placed on a back splint and prepared for operation.

The following day a curved flap was turned up and the tubercle exposed. It was replaced in position and retained by a single nail driven through its centre. The wound was then closed and the leg replaced on a back splint.

At the time of writing the wound is healed, the stitches have been removed and massage has been commenced on the muscles of the thigh.

The radiographs are the work of Private Rothbard and Sergeant Jones, Royal Army Medical Corps, respectively.

I am indebted to the Officer Commanding Military Hospital for permission to publish these cases.

EXAMINATION OF A FIELD COMPANY FOR SCHISTOSOMIASIS.

By Captain J. H. C. WALKER.

Royal Army Medical Corps.

The "X" Field Company Royal Engineers has been stationed at Ismailia for three years, and during part of this period it was the custom from time to time to carry out bridging operations on the fresh water canal.

This canal contains Nile water and is well known to be very dangerous from the point of view of schistosomiasis. This fact was not realized by either the officers or men of the company until June, 1924, when it was suddenly brought home to them by the occurrence of nine cases of urinary schistosomiasis.

Bridging operations had been carried out during November, 1923, and May, 1924, and at other times the men had been in the habit of washing in the canal.

The present investigation was suggested when a blood film sent for examination for malaria was noticed to contain an abnormal number of eosinophiles. A differential count showed eight per cent eosinophiles to be present, in excess of normal.

The patient, Corporal Q., had been admitted to hospital three days previously suffering from a slight febrile attack following prolonged exposure to the sun. He had no symptoms beyond a slight headache, but he stated

he had been on the bridging operations in November, 1923, and May, 1924. In view of the eosinophilia and his history, his urine and fæces were examined microscopically and the former was found to contain many ova of *Schistosoma hæmatobium* and scanty pus.

On account of the accidental discovery of this case and the previous history of the company, it was decided to examine all the men for schistosomiasis.

The total number of men examined was 132, of whom 109 were non-commissioned officers and sappers, and twenty-three drivers. The latter, who were not so liable to infection, were all found to be free from the disease.

All the fæces examined were found to be free from ova of any description.

At the first examination of the 109 sappers the following results were obtained:—

Urine positive for ova of *S. hæmatobium*	5
,, showing presence of pus, but no ova	8
,, ,, ,, ,, and blood, but no ova	1
,, ,, ,, blood	1
Negative	94

Positive cases were treated with tartar emetic immediately and the case of hæmaturia was admitted to hospital for observation.

The nine men who at the first examination were found to be passing pus or blood were then re-examined, the last few drops of urine being used. A differential count was also made.

Two of these men were found to be passing ova, and two, with a marked eosinophilia, were admitted to hospital for observation. One of these, after repeated examination, proved positive, and the other being negative is attending weekly for examination.

The remaining five were instructed to attend hospital twice a month for examination.

The case of hæmaturia was kept under observation in hospital and every specimen of urine passed for ten days was examined for ova. At the end of this time as his condition, which was fairly severe, had not improved and no ova had been found, he was placed under treatment following a cystoscopic examination. His condition immediately improved and he is now quite fit.

The cystoscopic examination showed the posterior bladder wall to be covered with numerous small submucous hæmorrhages and a few small whitish raised patches.

All the positive cases were apparently in perfect health and were carrying out their full duties.

A differential count was made on each case and the results which are tabulated below are of interest, in that there appears to be some relation between the extent of the eosinophilia and the number of ova passed in the urine. The fewer the ova the higher the eosinophilia. The amount of pus

present appears to increase with the eosinophilia and the decrease in the ova.

	Polymorphs	Lymphocytes	Eosinophiles	Basophiles	Large mononuclears	Remarks
No. 1	52·5	36·5	8·0	—	3·0	Ova + +. Pus scanty.
No. 2	55·0	30·0	10·0	1.0	4·0	Ova + +. Pus scanty.
No. 3	59·5	19·0	8·0	0·5	13·0	Ova + +. Pus scanty.
No. 4	—	—	8·0	2·0	—	Under treatment for gonorrhœa. Ova + +.
No. 5	50·5	27·5	15·0	·5	6·5	Ova scanty. Pus + +.
No. 6	50·5	24·5	17·5	1·0	6·5	Ova only found after repeated examinations. Pus + +.
No. 7	65·0	26·5	5·0	—	3·5	Relapse case. Ova scanty. Had treatment in June, 1924.
No. 8	37·0	30·0	22·5	1·5	9·0	One ovum found after several examinations. Pus + +.
No. 9	76·5	14·5	2·5	—	6·5	Ova not found. Severe hæmaturia. Put on treatment after cystoscopic examination. Immediately improved.
No. 10	58·0	25·0	11·0	1·0	5·0	Ova not found. Pus + +. Epith. +. Had urethritis six weeks before.

In conclusion I have to thank Lieutenant-Colonel L. M. Purser, D.S.O., R.A.M.C., for permission to publish these notes, and 7254692 Pte. J. E. Weston, R.A.M.C., for much labour with the hand centrifuge.

Report.

A REPORT (PART I) OF THE FOURTH CONFERENCE OF THE INTERNATIONAL UNION AGAINST TUBERCULOSIS, LAUSANNE, AUGUST, 1924.

By Colonel J. C. KENNEDY, C.B.E., K.H.P.

In attempting to give a general outline of the proceedings of this Conference, and some idea of personal impressions, it seems advisable to divide my report into sections under the following headings:—

(i) Outline of proceedings.
(ii) The discussions at Lausanne.
(iii) The Anti-tuberculosis Organization in Switzerland.
(iv) Tuberculosis in the Swiss Army.
(v) Impressions of a visit to various Anti-tuberculosis Centres in Switzerland.

I.

General Outline of the Proceedings.

The meetings of the Conference were held in the fine buildings of the University—the Palais de Rumine.

On August 5 the Conference was officially opened and addressed by:—

Dr. Dewez, President of the Swiss Confederation.

Dr. Morin, Chairman of the Conference.

Professor Leon Bernard, General Secretary of the International Union.

Professor Arthus, Dean of the Faculty of Medicine of Lausanne.

For three days the Conference remained in session, discussing subjects the details of which are given below.

In the intervals the members of the Conference were invited to visit the various anti-tuberculosis institutions of Lausanne and the neighbourhood, and each evening were the guests of the hospitable organizers of the Conference at receptions or social gatherings.

On August 8 the members spent a very pleasant day visiting places of interest on the Lake of Geneva at the invitation of the Swiss Confederation, and then proceeded on a tour round the principal anti-tuberculosis centres in Switzerland.

The itinerary of the tour was as follows: Leysin, Montana, Brigue, Thun, Berne, Davos, Arosa and Zurich, and occupied nine days. Fine weather was experienced most of the time, and, quite apart from its professional interest, the tour was most enjoyable, and organized with every thought for personal comfort.

II.

The Discussions at Lausanne.

First Subject.—Do there exist in nature, or can there be artificially produced, saprophytic varieties of Koch's bacillus which possess the power of becoming virulent?

Professor Calmette opened the discussion. After briefly discussing the morphological and physiological features of the paratubercle bacilli, pathogenic and saprophytic, he related the attempts that had been made to transform paratubercle into tuberculogenous bacilli. He mentioned in some detail those experiments in which it had been reported that the transformation had been effected, but gave it as his opinion, backed by his own experiments with the timothy-grass bacillus that such transformation was not yet proved, and concluded that "there is no reason for considering paratubercle bacilli, not definitely pathogenic, as offering any danger to man or to animals susceptible to tuberculosis."

Perhaps the most interesting part of his paper was, however, that which dealt with experiments directed towards transforming the tubercle into non-tuberculogenous acid-fast bacilli, his own experiments in collaboration

with Guerin being of particular interest. He had succeeded in causing tubercle bacilli to lose their tubercle-forming properties by maintaining them in a long series of cultures on a potato medium saturated with a five per cent glycerinated ox-bile. After 230 successive cultures carried out over a period of thirteen years, a bacillus was obtained which on ordinary glycerine media had definite characters always acid-fast, but absolutely avirulent for all species of animals, and incapable of giving rise to tubercles. This bacillus, nevertheless, contained toxic elements, and produced a tuberculin quite as active as that from normal tubercle bacilli. He had been using this bacillus for vaccinating young animals.

The discussion that followed indicated that there was a tendency to accept Professor Calmette's conclusions with reserve, and to consider that the transformation of paratubercle bacilli into tubercle-forming bacilli is a proposition that cannot yet be dismissed lightly.

Second Subject.—The relationship between pregnancy and tuberculosis.

The discussion was opened by Professor H. Forsner, of Stockholm. His able summary of the whole question, followed by his well-reasoned conclusions, based on extensive observations and experience, was a most valuable contribution.

Three aspects of the question were studied: (*a*) the influence of pregnancy on pulmonary tuberculosis; (*b*) the future of a child born of a tuberculous woman; and (*c*) the interruption of pregnancy in a tuberculous woman.

(*a*) After an exhaustive critique of the opinions expressed by many authorities, he related his own observations and summarized as follows: "The thesis of the detrimental influence is supported by the majority of doctors in various countries, but it is still only a theory, as it is based on the subjective impressions of a particular doctor in the development of a given case. . . . The truth of the problem has not yet been discovered, and still demands research. . . . I do not claim to have given a definite answer, but I do assert that our statistics show the error of the old theory of the ill-effects of pregnancy on tuberculosis."

By a carefully controlled observation on a series of pregnant tuberculous women, he finds no tendency, during the two years following pregnancy, to more rapid progress of the disease as compared with a similar series of non-pregnant women, so long as the disease has not passed Turban's first stage.

TABLE I.

	After one year's observation.			After two years' observation.		
	Improved or stationary	Aggravated	Died	Improved or stationary	Aggravated	Died
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Never pregnant..	75	23	2	59	27	14
Pregnant ..	71	28	1	60	28	12

In cases, however, that have progressed to the second and third stages of the disease statistics are unfavourable to mothers.

(*b*) As regards the future of the child of a tuberculous woman he took

exception to the opinion expressed by those who advocate interruption of pregnancy that the child of such a woman is a negligible quantity, and he quoted statistics to show that the average weight at birth of children of sputum-positive mothers is equal to the average weight of children of healthy mothers. Furthermore, he showed that children taken away from the harmful influence of familial—particularly maternal—tuberculosis can be brought up as easily as other children.

TABLE II.—RESULT OF OBSERVATIONS AFTER PERIODS VARYING FROM ONE TO THREE OR MORE YEARS.

Thirty-four children taken away from their mothers at birth :—		
Living and well	28	82 per cent
Living with tubercle	1	3 ,,
Died of tubercle	1	3 ,,
Eighty-nine children brought up by their mothers :—		
Living and well	46	52 per cent
Living with tubercle	22	25 ,,
Died of tubercle	18	20 ,,

(*c*) It was a natural corollary that he should strongly deprecate interruption of pregnancy, and he dismissed the question briefly, quoting, in conclusion, M. Lindhagen, "We know what we are sacrificing—a child—but we do not know what we shall gain."

Third Subject: The effects of the anti-tuberculosis campaign on the diminution of mortality from tuberculosis.

Sir Robert Philip, of Edinburgh, opened this discussion with a carefully-reasoned paper, presenting the facts in relation to two countries, where measures on a broad basis have progressively developed throughout a quarter of a century or more, namely, Great Britain, particularly Scotland, and the registration areas of the United States of America.

Before considering the effects Sir Robert made it clear as to what was included in his conception of a satisfactorily organized anti-tuberculosis campaign. The headquarters in any given area should be the tuberculosis dispensary; it should be the "nodus" linking the various lines of operation, a centre for diagnosis, observation, treatment, examination of contacts and environmental conditions and of propaganda; and through the tuberculosis officer a perfect liaison should be kept up between this organization and the general practitioners of the area. The dispensary should work in close touch with the Tuberculosis Care Committee. These constitute the first unit of the British tuberculosis scheme. The second unit includes the various institutions—sanatoria, hospitals, schools and working colonies.

After a rapid survey of the development of the British scheme in which the establishment in 1887 of the tuberculosis dispensary in Edinburgh, and the promulgation of the Edinburgh Tuberculosis Scheme in 1898, were two important landmarks, he stated that on January 1, 1924, the tuberculosis service in England and Scotland stood as follows :—

Tuberculosis dispensaries	475
Tuberculosis officers	420
Sanatoria, hospitals, colonies, etc. Number of beds	24,031

In discussing the effects, Sir Robert quoted very largely from figures supplied by the Registrar-General for Scotland, and these were sufficiently striking. There has been a remarkable diminution from all tuberculosis and from pulmonary tuberculosis respectively throughout the period 1871-1921. Charts were used to illustrate the continuous drop in mortality and brought out further that the downward trend in mortality has actually accelerated in recent years. The following extract from his tables shows the drop in mortality in periods of ten years.

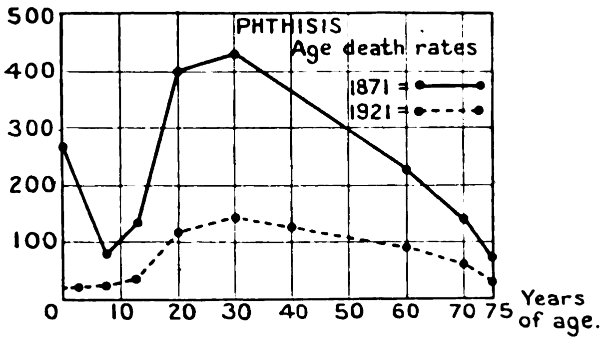


CHART 1.

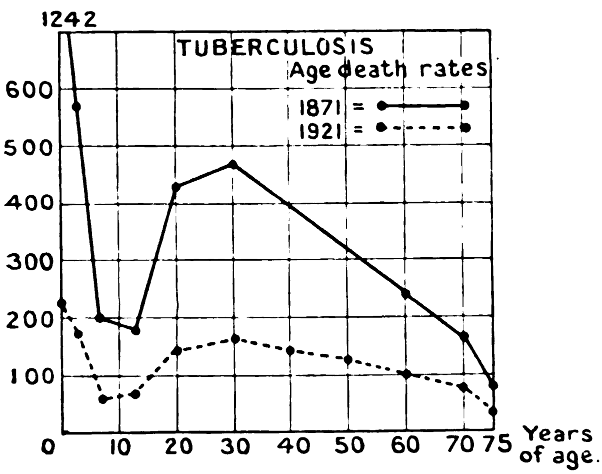


CHART 2.

TABLE III.

SCOTLAND.	All tuberculosis. Number of deaths	per 100,000 of population		Pulmonary tuberculosis. Number of deaths	per 100,000 of population
1871	13,011	386	..	9,102	270
1881	11,275	301	..	7,739	207
1891	10,141	251	..	7,361	182
1901	9,911	221	..	776	151
1911	8,387	177	..	5,451	115
1921	5,737	117	..	3,946	81

The next extract gives the ratio of deaths from tubercle to total deaths from all causes over the same period, and it will be noted that the percentage of deaths from tubercle has fallen from 16·8 to 9·0.

TABLE IV.

Mortality rate per 10,000 living	1871	1881	1891	1901	1911	1921
From all causes	221·8	193·3	207·1	178·9	151·0	135·6
From all tubercle	37·3	31·1	24·5	22·4	17·8	12·2
Percentage of all deaths due to tubercle	16·8	16·0	11·8	12·5	11·7	9·0

Comparative results were quoted from England and the United States.

In order to forestall the criticism that this fall in mortality from tuberculosis is but an expression of the fall in the general death-rate it was shown that during the period of fifty years (1871-1921) while the death-rate from all diseases was reduced by less than one-half, the death-rate from tuberculosis was reduced by more than two-thirds. By a further analysis it was brought out that the reduction in mortality has occurred conspicuously in the younger ages, a point of considerable interest which is demonstrated in the preceding charts by Sir Robert.

Sir Robert calculated that had the death-rate of 1871 prevailed in 1921, there would have occurred 13,335 deaths from pulmonary tuberculosis in Scotland, whereas in actual fact there were only 4,091. In other words, there was a saving of life to the extent of 9,244.

III.

The Anti-tuberculosis Organization in Switzerland.[1]

It was in the middle of the last century that attention was first directed towards the beneficial effects of high altitudes in cases of tuberculosis. It was at Davos that the treatment was first instituted by Ruedi, and his work was followed up by men like Spengler and Turban, with the result that the principle of the treatment was established. By the end of the century Switzerland had earned a European reputation and had become the resort of thousands of foreigners seeking relief from their tubercular symptoms.

About this time it began to be borne in on the Swiss, as the result of the work of various investigators such as Naegeli at Zurich, that their own nationals were seriously infected with tubercle, and the extent of the infection demanded measures of prevention, treatment and isolation which would be applicable to their poorer and indigent classes. The immediate result of this was the formation of local committees in the larger towns to organize treatment centres, and adopting the principle of treatment at

[1] The particulars given in Sections III and IV are taken from a publication of the Swiss Association against Tuberculosis, entitled "La Lutte contre la Tuberculose en Suisse."

high altitudes they opened "popular" sanatoria at several of the hill stations for the reception of the poorer and indigent people.

In order to centralize the work of the various committees, there was founded in 1902 the "Commission Centrale Suisse pour la lutte contre la Tuberculose." This body, by superintending and advising the local organizations, did much to place the anti-tuberculosis organization of the country on a sound footing, and the progress of the campaign since that date has been uninterrupted. In 1919 the Commission Centrale became the "Association Suisse contre la Tuberculose," in conformity with other, national associations. It is interesting to note that it was not till 1906 that the dispensary system was adopted by the Swiss, who in this respect were behind Britain (*vide* Sir R. Philip's paper).

The first popular sanatorium was opened at Heiligenschwendi in 1895 with forty-five beds, and the following figures show what progress has since been made in that direction.

TABLE V.

	Number of popular sanatoria	Number of beds	Number of sick treated in the year
1895	2	57	93
1900	6	370	1,355
1910	11	900	2,800
1920	18	1,500	4,500
1922	22	2,000	5,029

To the figures for 1922 there fall to be added 1,200 beds for children, making a total of 3,200 beds for the treatment of tubercle, or one bed for 1,200 of population. So far as possible, sanatorium treatment is carried out in the various hill stations, as the Swiss entertain no doubts as to the very beneficial influence of high altitudes.

While the National Association exercises general supervision the actual details of administration are carried out by the local committees or leagues, and as an illustration we may take the League of the Canton of Vaud, or rather that part of its organization that deals with the city of Lausanne which the members of the Congress were privileged to see.

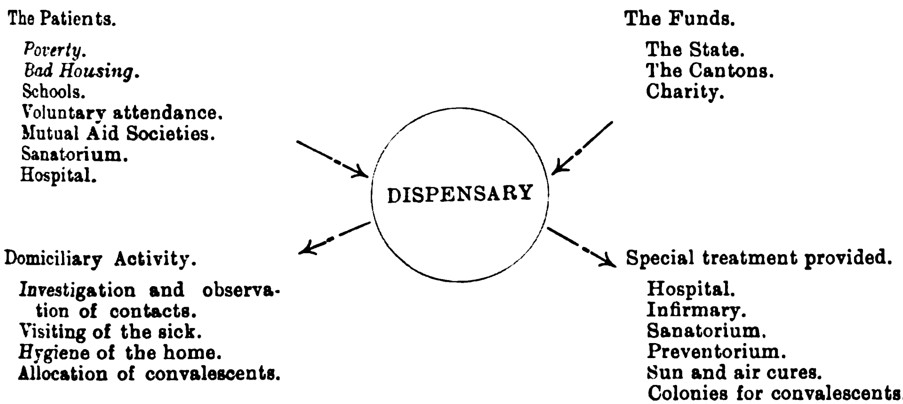
The scheme is centred on the anti-tuberculosis dispensary (D.A.T.) which is a branch of the Polyclinic founded in 1906. The operations of the dispensary are conveniently indicated by the following scheme adapted from a brochure entitled "20 années de lutte anti-tuberculeuse à Lausanne."

SCHEMA OF THE WORKING OF THE D.A.T.

The work of the dispensary is carried out by three doctors, three visiting nursing sisters, two secretaries and two pupil nurses assisted by Red Cross volunteers, and a subsidiary D.A.T. was opened in the following year in connexion with the Infirmary of Lausanne.

A very important part of the organization consists n measures of prevention and in the treatment of early, incipient or dormant cases, particularly in children and adolescents. During the summer months several establish-

ments are open for preventive treatment. At Vidy-Plage we saw about 200 children of all ages undergoing a sun and gymnastic preventive cure. Three times a week these children, drawn from the poorer parts of the town, spend the afternoon devoid of all but the scantiest clothing, playing games and being instructed in gymnastic exercises. Then there are three summer colonies for children definitely threatened with tubercle, two of twenty beds and one of twenty-eight beds. In these establishments full advantage is taken of the sun and air cure, and the results are said to be excellent. Adults as well as children are provided for in still another establishment.



Beds for cases requiring hospital treatment are found in four hospitals giving a total of about 100 beds.

Outside Lausanne there are a number of establishments such as Les Orsillons accommodating fifty girls of 6 to 13 years, removed from infected families. This is practically an open-air school. La Nichée is a similar institution for boys. La Clairière is a preventive institution for girls and young women of 16 to 25 years; cases of definite tubercle are not admitted. For young women with non-active tubercle twenty-four beds are provided at Leysin in an annexe to the popular sanatorium.

There is no doubt that Lausanne is admirably adapted to this campaign of prevention, situated as it is on a slope overlooking the lake with an open southern aspect.

The Canton of Vaud has a population of 315,000, and its annual death-rate from tuberculosis is 700. During 1923 the number of people who benefited from the various activities of the league was 7,062, of whom 4,647 were children. The expenses for the year amounted to 604,658 francs.

Similar organizations are maintained in other Cantons.

The anti-tuberculosis associations and leagues in Switzerland number sixty-two, and they operate through thirty dispensaries and numerous commissions and sections. Three thousand two hundred beds are provided in sanatoria and preventoria, and a number of special beds in hospitals, in

the former 4,000 to 5,000 people are treated annually, and in the latter about 8,000. The Swiss, with a population of about four millions, spend 10 to 12 million francs annually in their anti-tuberculosis campaign, and it is evident that they are now reaping their reward.

From 1881 to 1920 the mortality from tuberculosis decreased from 33 to 20 per 10,000, a gain of 40 per cent. At the same time, however, this is little more than an expression of the fall in the general mortality rate.

While stress has been laid in this brief account on the more obvious activities of the Association, the Swiss realize that educational, hygienic and eugenic propaganda were of fundamental importance.

IV.

Tuberculosis in the Swiss Army.
L'Assurance Militaire (A.M.).

Insurance of soldiers against sickness or accident has been fully established in Switzerland by appropriate legislation. The future of the sick soldier is very generously assured provided that the man was healthy on enlistment, and the illness manifested itself in the course of his service, or at the latest in the course of the following three weeks. Exceptions to these two principles, however, may be made in the favour of the invalid: on the one hand by prolonging the period during which he may report to the "médecin-en-chef," and on the other hand by taking into account the cases which have been kept on service in spite of a disability declared on enlistment, and of those where a malady already existing, although unknown to the individual, would have been aggravated by, not attributed to, service. These provisions apply frequently to tubercle, on account of the chronic nature of the disease and the difficulty of forming a definite opinion as to the date of origin.

The benefits afforded to the tuberculous soldier by the Assurance Militaire are considerable—free treatment in a hospital or sanatorium, with pay or an out-of-work allowance (2·10 to 10·50 francs a day). Men without dependants draw only half the allowance while in hospital. In case of invaliding, pension is granted to the extent of seventy per cent of the sick allowance. In case of death a pension is given to the survivors. Treatment may be granted at home if not inconvenient.

In the course of the Great War, on account of the permanent mobilization of the greater part of the army, the obligations of the Assurance Militaire increased to an extent hitherto unknown. For tuberculosis in particular it was found necessary to open fifteen sanatoriums, and to-day those at Davos and Leysin are still functioning, and treat 150 sick. For two years it was found necessary to establish a depot where all cases were sorted out and appropriately disposed of. In 1922 there was founded an establishment for "la cure de travail" of 100 military convalescents. In

this work colony about one-third of the patients are only slightly affected, and are put to work under medical supervision; the work is varied, consisting of farming, gardening and vine culture, bee-keeping and rural carpentry, and on the average is limited to five and a half hours a day. The results obtained have been very encouraging.

In addition to providing for the sick, the Assurance Militaire has been of service in collecting information. During mobilization large numbers of men were examined, all cases of tubercle were controlled, the diagnosis carefully established, and the cases followed up. Furthermore, the cost of this is known. The records for 1914 to 1917 are fairly complete, but unfortunately in 1918 the epidemic of influenza, affecting 30,000 men, upset statistics, and at the same time, for reasons of economy, the urgent necessity of reducing the clerical personnel prevented as close a study of statistics from the point of view of tuberculosis as the importance of the subject warranted.

The following figures are extracted from a report of the Swiss Association:—

TABLE VI.

	Cases of tubercle treated in military sanatoriums	Deaths from tubercle	Percentage of total deaths due to tubercle
1911	120	9	—
1912	184	12	—
1913	187	7	—
1914	107	25	11·7
1915	688	70	23
1916	790	67	32
1917	1,244	105	34
1918	2,168 ?	93	42
1919	3,801	71	44
1920	2,058	105	73
1921	1,435	85	69
1922	1,071	82	70

? The figures for this year and the subsequent years are not accurate for the reasons stated above.

The average annual strength of the army is not given, so that the admission ratio cannot be estimated, but it is noted that in the years 1912 and 1913 the ratio for invaliding for tuberculosis was 4 and 4·2 per 1,000. of strength respectively. By way of comparison the corresponding figures for the British Army were 1·18 and 1·7. The high rate of mortality from tuberculosis will be noted. Even neglecting the figures for 1918 and subsequent years which are stated to be inaccurate, and taking an average only of the years 1914-17, we get the extraordinary figure of thirty-four deaths from tubercle in every 100 deaths from all causes. The figure admitted by the writer of the article is thirty-nine. This figure should be compared with the corresponding figure for the Swiss civil population which is round about fifteen.

Further evidence of the extent of the disease is afforded by statistics of recruiting:—

TABLE VII.—NUMBER OF MEN REJECTED PER 1,000 EXAMINED.

	For tuberculosis of lung	For other tuberculosis	All tubercle
1912	9·40	3·80	13·20
1913	8·80	3·10	11·90

Corresponding figures for the British Army are:—

1912-13	1·02	1·12	2·14
1922-23	1·18	1·96	3·14

It will be seen, therefore, that tuberculosis is a serious cause of disability in the Swiss army, and this fact is important as enabling one to deduce the health of the population as a whole. If tuberculosis exacts such a toll in the *élite* of the young manhood of the country, living presumably under healthier and more hygienic conditions than a considerable proportion of the people, how can the latter escape a high degree of infection?

As already explained, the Assurance Militaire is responsible for the tuberculous soldier even after his discharge from the service. This involves considerable expenditure, as may be imagined.

It is estimated that every tuberculous soldier costs on the average 1,700 francs compared with an average of 300 francs for each soldier sick from other causes. During the period 1914-17 the Assurance Militaire spent 3,775,515 francs in the treatment and maintenance of tuberculous soldiers.

Reviews.

MEMORANDA ON MEDICAL DISEASES IN TROPICAL AND SUB-TROPICAL AREAS. Fourth Edition, Revised with additions by Brevet Lieutenant-Colonel W. P. MacArthur, D.S.O., O.B.E., M.D., F.R.C.P.I., Royal Army Medical Corps. Published by His Majesty's Stationery Office. Pp. 275. Price 2s. 6d.

Many medical men who served with the British Army during the world war are probably familiar with the early editions of this invaluable vade-mecum of tropical diseases, compiled originally by Lieutenant-Colonel Andrew Balfour, C.B., C.M.G., who was also responsible for the second and third editions issued during the period of the war; a period in which medical research, activated by the dire necessity of maintaining the efficiency of the military machine, made considerable progress.

At a meeting of the Army Pathology Advisory Committee, held in October, 1923, it was decided to act on the suggestion of the Director General, Army Medical Services, that the time was ripe for the preparation of a new edition of the Official Memoranda on medical diseases of warm climates, in which would be embodied the essential results of medical

research during and subsequent to the war period. As Dr. Andrew Balfour, C.B., C.M.G., a member of the Committee, was about to proceed abroad, the task of revision was on Dr. Balfour's suggestion delegated to Lieutenant-Colonel MacArthur, Royal Army Medical Corps, the Professor of Tropical Medicine at the Royal Army Medical College.

The work of revision and amplification has been admirably done without increasing the size of the handbook, which can easily be carried in the coat pocket.

Thirty-two common diseases, in addition to a variety of skin diseases, with which the practitioner frequently has to deal as affecting natives and Europeans in the tropics, are precisely and succinctly described as regards their ætiology, symptoms, diagnosis, prophylaxis and treatment. The diseases are arranged in alphabetical order, and under each heading there follows an admirably written and thoroughly practical *précis* of what is certainly known about pathological, sanitary and clinical aspects of the disease and the best methods of treatment, right up to the very latest advance in the knowledge of the subject.

In this connexion the article on blackwater fever is especially good, and the chapter on fevers in the East is a lucid exposition of the classification and diagnosis of those common and obscure febrile conditions the cause of which so often puzzles both pathologist and physician.

The sections on preventive and curative treatment are all very good; they have the merit of being dogmatic; we are told exactly the best that can be done, and we are left in no uncertainty as to the choice of a method nor the technique of its application.

In addition there is a most valuable chapter on arthropod pests, winged and wingless, in which their natural history, simple means for their identification, and the most practical and effective methods of combating these pests are clearly described.

A new feature of the book is an Appendix in which the principles of zoological nomenclature, as defined by the International Commission on Zoological Nomenclature, are fully explained.

The book is not written for the laboratory worker, but the necessity of laboratory assistance is strongly emphasized; it is essentially a practical guide for use in the field and at the bedside, a ready book of reference for the young medical man who may be called upon to advise for the prevention and to carry out the treatment of common tropical diseases, and of certain other diseases, as they occur in armies, ships, plantations, mines, railways, public works, or amongst pioneers operating in warm climates.

This most readable and instructive little book should be in the kit of all military, naval and mercantile marine medical officers. It will be of great value to all medical men who in any circumstances whatsoever may be called upon to practise their profession habitually or occasionally in the tropical and subtropical parts of the earth.

We commend it also to candidates reading for diplomas in tropical

medicine. They will find it useful as an aid and a "refresher" to supplement the study of the larger textbooks.

The only regret we have in laying down the book is that there is not a little more of it. We would like to see filariasis more fully treated, and there is no mention of sprue. The text is well illustrated by a selection of drawings and charts. A list of contents at the beginning of the book and a well-arranged index at the end facilitate quick reference to any point the reader may desire to look up.

A SYSTEM OF SURGERY. Edited by C. C. Choyce. Pathological Editor, J. Martin Beattie. In three volumes.

This second edition of this system was arranged for in 1914 but its preparation was delayed by the war, and it was not until 1921 that the work could be begun. Following on the advances in surgery made during the war, important additions to our knowledge of vascular injuries, hæmorrhage, fractures, infective wounds, gangrene, etc., have been included. Several of the articles have been re-written and the rest thoroughly revised and brought up to date—150 new illustrations, including some fifty new plates have been added.

The system as a whole has been excellently got up, the coloured plates and illustrations being of the highest character. The list of contributors, each dealing with his special subject, speaks for itself. At the end of each section is a full bibliography. There is a good index to each volume, and at the end of the third volume there is, in addition, a general index to the work.

The first volume deals with General Surgery, commencing as usual with bacteriology, inflammation, suppuration, etc.

The section on gangrene is very well presented by Mr. C. A. R. Nitch—a new classification is employed. Gas gangrene is well and fully discussed with good illustrations.

The section on tumours by Mr. Raymond Johnson is one of the outstanding features of this volume. It is profusely illustrated, including several coloured plates. This account of the pathology of tumours is as good as can be found anywhere in the literature.

The article on X-ray diagnosis has been re-written by Mr. Magnus Redding, those on acquired and congenital syphilis by Lieutenant-Colonel Harrison and that on tetanus by Colonel West.

The section on anæsthesia includes a full account of spinal anæsthesia by Mr. Lawrie McGavin. In the section on general anæsthesia no reference is made to the intratracheal method of giving ether.

A good account is given of the surgery of tropical diseases by Mr. Daniells and Mr. Low and also of surgical diseases caused by animal parasites, snake bites, etc.

Volume II contains the surgery of the breast, by Mr. Sampson Handley, giving his very important work on the dissemination of breast carcinoma

and full accounts of the operation for mammary cancer, the use of radiation in the treatment of this condition, and the operation of lymphangioplasty.

Diseases of the tongue, by Mr. Clayton Green, includes a very good description of the operations for carcinoma.

Surgery of the stomach and duodenum, by Mr. Sherren, is short and concise. The main points are included and good accounts of the chief operations are given.

The intestines are dealt with by Mr. Miles. This section is plentifully illustrated, including some good coloured plates.

The appendix is dealt with as a separate entity by Mr. Sargent and Mr. Maybury, who also contribute an article on the peritoneum.

Hernia is very thoroughly described by Mr. McGavin, and includes good descriptions of the operative treatment of the different varieties and also very helpful accounts of the after-treatment.

Mr. Clegg deals fully with the surgery of the rectum and anal canal.

Diseases of the liver, gall-bladder, bile passages and pancreas are described by Mr. Grey Turner. This section is especially well illustrated; it includes a good account of the anatomy of the region.

The surgery of the urinary tract is described very thoroughly by Sir John Thomson-Walker. It is well illustrated and includes a large bibliography.

The volume is concluded with the surgery of the male genital tract by Mr. Russell Howard.

Volume III.—The female genital tract, by Mr. Victor Bonny, includes a full description of the main aspects of this branch of surgery that are dealt with by the general surgeon—a full description as compared with the usual surgical textbook.

The cardio-vascular system is described by Mr. E. Rock Carling.

The lymphatic system by Mr. J. F. Dobson gives a very good and full description of cervical adenitis with detailed account of the operative treatment, also an extremely useful account of the glandular invasion of carcinoma. The section on the surgery of the neck by Mr. Arthur Edmunds is a new and useful method of presenting the surgery of this region. It deals mainly with the goitres and includes also injuries, congenital defects, etc.

The nose and accessory sinuses are described by Mr. Harold Barwell. The pharynx, naso-pharynx, larynx and ear by Mr. Norman Patterson.

The lungs and pleura by Mr. H. Morriston Davies contains a good account of the surgical treatment of bronchiectasis and lung tuberculosis.

Mr. Sherren deals with injuries and diseases of nerves; this section is confined to forty-three pages, which seems considerably out of proportion compared with other sections.

There is an excellent description of the surgery of the scalp, skull and brain—intracranial hæmorrhage, brain abscess and tumour, are specially

well described; as is also the surgery of the spinal cord by the same author and Mr. Gwynne Williams.

The jaw is described by Mr. D. C. L. FitzWilliams; skin and subcutaneous tissues by Mr. T. G. Legg.

Muscles, fasciæ and tendons, by Mr. E. Rock Carling; Bursæ by Mr. E. D. Telford.

Diseases of bone by Mr. C. C. Choyce, who also does the section on joints.

Fractures are described by Mr. E. W. Hey Groves.

Orthopædic surgery by Mr. Trethowan. In this section a maximum amount of information is condensed into a limited space.

Taking the work as a whole the various sections are worked out on the same lines. Commencing with a short account of the anatomy they include quite a number of descriptions of operations and also the after-treatment, so that there is a large amount of systematized information contained.

It is a collection of monographs on the various systems, each written by recognized experts, and can quite fairly be said to represent the best teachings of modern surgery. J. M. W.

A Manual of Practical Chemistry for Public Health Students. Second Edition. By Alan W. Stewart, D.Sc., A.I.C.Lond. Bale, Sons and Danielsson, Ltd. 1924. Pp. 83. Price 5s.

This little handbook is a guide to the practical chemistry exercises required under the present regulations for students working for the D.P.H.

It presents a good choice of methods, and the processes are lucidly and concisely described; but some valuable methods have been omitted. We look in vain for mention of Haldane's apparatus for air analysis and for the Gerber or Rose-Gottlieb methods for the estimation of fat in milk. In view of the widespread use of Gerber's method in dairy and public laboratories this omission is especially unfortunate. Moreover, when referring to the deterioration of bleaching powder no mention is made of the prevention of this deterioration by the addition of quicklime—and the author, in quoting American figures for the composition of flour, seems to be unacquainted with the work of Plimmer, who has published an authoritative series of British food analyses.

The volume is interleaved with blank pages, and there is a very full table of contents, but no index.

We notice very few mistakes in the book—but we would point out that in two places nitrates should read as nitrites, and the food value of milk refers to kilo-calories and not to gram-calories as printed, and on p. 77 several of the terminal decimal figures require correction.

Despite these minor defects, we consider the book to be one of the best laboratory pocket-books for workers whose requirements are limited to the prescribed course for the D.P.H., but it does not purport to be a textbook on public health chemistry. J. A. A.

Clinical Methods. By Robert Hutchison, M.D., F.R.C.P., and Harry Rainy, M.D., F.R.C.P.Ed., F.R.S.E. Eighth Edition, revised throughout. Cassell and Company, Limited. 1924. Pp. xiii + 688. Price 12s. 6d.

For a book of such unusual popularity, it is not surprising to find a new edition appearing. Its predecessor, the seventh, was published only four years ago and has been reprinted three times since.

The eighth edition was prepared by Dr. Hutchison. He has "scrapped" several methods that have become obsolete and added new sections and some new figures. There is a new coloured plate showing the spectra of hæmoglobin and its derivatives compared with the solar spectrum. The new additions to the book include sections on the Fractional Test-Meal, Van den Bergh's Test, the estimation of Sugar and of Urea in the Blood, the Urea Concentration Test; the description of Cardiographic Methods has been entirely re-written.

"Clinical Methods" has now been in existence for no less than twenty-seven years without losing any of its popularity. The practitioner, the Service medical officer, and the student all find its value undiminished. It is an old friend and constant helpmate that has accompanied most of us from our student days onwards through our wanderings—in dressing station, sick bay, or the more affluent surroundings of a consulting room. So a little sentimentality over an old pal, still recognized by red binding and rounded edges, still able to get into pocket or haversack—for girth has not increased with advancing years—is pardonable.

The secret of its youth lies in its vitality. Here is a small book at a reasonable price which is full of first-class material, easily read and assimilated.

M. B. H. R.

A Synopsis of Special Subjects. London: H. K. Lewis and Co., Ltd. 1924. Pp. viii + 376. Price 18s. net.

"A Synopsis of Special Subjects" is an original type in medical literature, as it is a synopsis indeed; the term in this case does not mean a textbook. The publishers have brought out a practical synopsis which is designed to supply any information that may be required by the practitioner during a busy round of visits.

The choice of special subjects was made on the advice of medical men actually in practice; these subjects are Dermatology, by H. C. Semon, M.A., M.D., M.R.C.P.; Obstetrics, by Malcolm Donaldson, B.A. F.R.C.S.; the Ear, Nose and Throat, by Archer Ryland, F.R.C.S.Edin.; and the Eye, by J. F. Cunningham, O.B.E., F.R.C.S. Each of these sections has its own index. All the way through the book everything is tabulated and condensed. There does not appear to be a single unnecessary word.

The book does not claim to be ambitious, nor of literary merit, but it is essentially practical. Information here and there may seem to be scanty,

but this indicates that the authors have limited their advice to matters that are really useful, and avoided the common error of "padding" by alternative lines of treatment, &c.

If this venture into synoptic literature is successful the publishers propose to increase the number of special subjects in future editions. So we may expect to see further editions, as this one will soon demonstrate its utility and popularity among students and practitioners.

M. B. H. R.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

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Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W.1.

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Original Communications.

AN ANALYSIS OF THE PRESENT STATE OF OUR KNOWLEDGE RELATING TO *ENCEPHALITOZOON*.

BY H. M. WOODCOCK, D.Sc.LOND.,
Fellow of University College.
(*From the Protozoological Laboratory, Lister Institute of Preventive Medicine.*)

As I am at present engaged upon the study of *Encephalitozoon cuniculi* and allied forms[1], a brief outline of the facts already known with regard to it, and some consideration of a few noteworthy points, will not only aid me in focusing my own present ideas, but may also, I hope, be of interest to readers of this Journal. In order not to appear to arbitrarily prejudge the question, and to avoid continual repetition of its long name, I shall refer to *Encephalitozoon* as a parasite or organism, rather than as a "body" or thing.

In writing this summary, I wish to acknowledge my indebtedness to the comprehensive review of the literature on spontaneous and experimental encephalitis in rabbits, by Da Fano [7], which includes data abstracted from certain papers which I myself have, unfortunately, not been able to see.

THE EARLIEST DISCOVERY.

The history of the discovery of *Encephalitozoon* furnishes another striking example of the accidental observation of something new during the investigation of other problems. It seems now established that the first workers to see this organism were Wright and Craighead in 1922 [31] during the course of their attempts to infect rabbits with the virus of human infantile paralysis. These attempts failed, but incidentally, and

[1] With the aid of a grant recently awarded me by the Medical Research Council for this purpose.

presumably accidentally, a paralytic disease of young rabbits was observed, associated with the presence of an organism showing definite characters. This disease corresponded essentially with that now known as spontaneous encephalitis or encephalo-myelitis of the rabbit. In the nervous system of the affected animals small focal lesions were present, both in the grey and white matter of the brain and cord. These lesions consisted of infiltration by small inflammatory cells, with rounded or irregular nuclei; polymorphs were noticeably scarce. In the white matter, the foci of infiltration were often associated with blood capillaries, and the nerve-cells in these areas were diminished in number or else lacking. Occasionally, a degenerated or necrotic nerve-cell was seen.

The organisms occurred either scattered among the infiltrating cells, or in nerve-cells, at times in numbers. Further, compact aggregations of the parasites were seen in round or oval spaces in the tissue, of about the size of a large nerve-cell. Sometimes, the body of the nerve-cell may be reduced almost to a shell, enclosing the clump of organisms; and the spaces probably represent completely destroyed nerve-cells, only the mass of parasites persisting. These clumps occurring in spaces are not always closely associated with the focal lesions, and there may be no evidence of inflammatory reaction around them.

In addition, lesions of essentially similar character were present in the kidneys. They occurred chiefly in the medullary portion and consisted of multiple small foci of infiltration by small-celled elements possessing a round, indented, or even fragmented nucleus. In the infiltrated zones there was a noticeable degeneration and disappearance of the epithelial cells. The parasites occurred mostly in closely-packed clumps in the epithelial cells, but also in the lumina of the tubules in varying numbers, along with free cells and detritus. The number of epithelial cells containing the organism is relatively small, and they are scattered, that is to say, groups of adjacent cells are not found infected. The organisms were observed in the urine during life, and hence the spread of the disease by a contaminative mode of infection could be understood.

As regards the organisms themselves, Wright and Craighead described them as being sharply defined, elongated in appearance, with rounded or conical ends, but slightly variable both in form and size. The length and breadth were probably never more than 4 and 1·5 microns respectively. The organisms showed often one or two lighter areas, but a definite nucleus was not made out. They stained by Gram's method and were, to a certain extent, acid-fast. They were also stained by methylene-blue. The authors concluded by considering that the nature of the organisms was doubtful, but they probably represented a stage in the life-cycle of some protozoan parasite—a sound and cautious attitude which might advisedly have been followed by several recent workers, not protozoologists, who have, without any definite evidence, rashly assigned them to the group of the Microsporidia.

I have given the above full abstract from Wright and Craighead's paper because, as a matter of fact, their accurate and concise original description has been really very little added to, in spite of numerous accounts by other workers, certain of whom have independently re-described both the lesions and the organisms, entirely unaware at the time of the above account. These subsequent observations have been made largely as a result of experimental work on the viruses of epidemic encephalitis and (or) herpetic conditions, i.e., in the course of attempts to transmit and maintain such viruses in rabbits. It is out of the scope of this review to enter into any general discussion of this difficult and still unsettled question. I will only point out here that, quite apart from that subject, it is now generally recognized that rabbits (and, indeed, certain other animals, as will be seen later) are liable to a form of spontaneous encephalo-myelitis; and this has been the cause of much confusion and error.

The Recognition of the Occurrence of Spontaneous Encephalo-myelitis in Rabbits.

The difficulty has been in large part due to the fact that such a condition may be present in the nervous system without manifest symptoms being exhibited by the animals. Not seldom, however, circumscribed laboratory epizootics occur, the development of symptoms being to a certain extent influenced by keeping the animals in cages for considerable periods, as also by experimental procedures upon the central nervous system (Da Fano [7]). The earliest worker to hint at the existence of such a spontaneous condition was Bull [3]. In the brains of rabbits, which this author had used for experimental infection with streptococci from cases of poliomyelitis and from other sources, he observed perivascular infiltrations, and also focal areas of necrosis of nerve-cells, surrounded by cells of lymphocytic type. The particular origin of the streptococci made no difference to the morbid histology, which presented a quite different picture from that to be seen in poliomyelitis, whether in man or monkeys. As, moreover, Bull found a similar condition in one rabbit out of several examined, belonging to a stock in which snuffles prevailed, he ventured the suggestion that these lesions were already present in the experimental animals when they were inoculated. He concluded that lesions of this character, obviously not specific, may be the result of bacillary infections to which rabbits kept under laboratory conditions are subject. No suggestion was made as to a filter-passing virus being the cause, although it may be noted that the animals inoculated with the streptococci from the cases of poliomyelitis were, *ipso facto*, also inoculated with the agent of that disease, which, as Bull himself points out, is a filter-passer. Some years later (1922) Oliver [25] definitely recorded a spontaneous meningo-encephalitis of rabbits, and this worker also pointed out the necessity of distinguishing these characteristic chronic lesions, occurring

in apparently normal animals, when studying the effects of the experimental inoculation of viruses. Oliver's work dealt with the reactions following the administration of arsphenamine. It was found that the same microscopical abnormalities in the central nervous system were shown, not only by rabbits which died after a period extending up to ten days from the administration, but also by those which died almost immediately; and, further, by apparently normal stock rabbits, which were examined in consequence of the preceding observation. The percentage of animals in which the lesions were found was the same, moreover, in the different cases, namely, about twenty per cent. No organisms could be detected whatever method of staining was used with a view to their demonstration.

Considerable, and in my opinion, important, developments of the subject were made by C. C. Twort, alone and in collaboration with Archer, the full account of which was given in a paper by these two workers jointly [18]. Twort and Archer observed a fatal nephritis in rabbits, both experimentally produced and occurring spontaneously in stock animals. Similar observations, they point out, had been previously recorded by Bell and Hartzell [2]. But great interest attaches to Twort and Archer's work because they were able definitely to connect the nephritis with the occurrence of alterations in the nervous system. This association was not by any means an invariable one, but it occurred in a certain proportion of cases. And the highly important conclusions were reached that (*a*) the spontaneous nephritis and the spontaneous encephalo-myelitis are caused by a single virus, and (*b*) this virus *is a filter-passer of nervous origin*. The crucial experiment on which the authors based these conclusions was, briefly, as follows: Two litters of four young with their mothers were used. The young of one litter were injected intracerebrally with a small quantity of an emulsion of spinal cord, preserved in fifty per cent glycerine in saline, in the cold, for six months, from a rabbit which had died from spontaneous encephalo-myelitis. The mother was left with her young as control. The second litter with their mother were placed in an adjacent cage, a few cubic centimetres of the glycerinated emulsion being sprayed on the bedding in the cage. The four inoculated animals died at intervals of from three to four and a half months after inoculation, and the mother five months after. The second litter and their mother were still living and apparently healthy at the time of writing. The duration of acute illness was from one to two days. The animals died with all the symptoms of acute nephritis. Cultures from the blood and various organs remained sterile. It may be noted that no reference is made to any observation of an organism or parasite resembling *Encephalitozoon*.[1]

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[1] Levaditi and his collaborators state, however ([18] footnote, p. 672) that Twort saw the parasites himself before the publication either of their own notes or of those of Doerr and Zdansky, and had, moreover, shown preparations containing them.

Recent Work on the Parasites and their Relation to the Lesions.

We come now to what may be termed the re-discovery of this organism, in association with lesions of the above-described character, which was made with a certain amount of *éclat* and, almost inevitably, with a certain amount of controversy as to actual priority, by Doerr and Zdansky, in Basel, and by Levaditi, Nicolau and Schoen, in Paris, in 1923; both groups of workers being unaware of Wright and Craighead's original description the year before. References to their preliminary announcements are given in the list at the end of this summary; for our present purpose it will suffice to abstract the chief points of importance from their more recent and fuller accounts [10] and [18] respectively. The French workers rather attempted to maintain that, in the earliest notes of the Swiss authors, the elements described were not, in reality, *Encephalitozoon;* but in taking this line they were, I think, undoubtedly mistaken. Moreover, in the published figures of Doerr and Zdansky, accompanying their more detailed paper (loc. cit.), the organism appears in many cases identical with that shown in several of the figures of Levaditi, Nicolau and Schoen.

Doerr and Zdansky first observed the parasites in preparations placed at their disposal by the Swedish worker, Kling. The material had been obtained from the brains of rabbits infected with the "Swedish virus" of Kling, Davide and Lilienquist, which these workers were inclined to regard as that of epidemic encephalitis, but this point is uncertain; according to Levaditi, Nicolau and Schoen, it was that of spontaneous epizootic encephalitis. On re-staining the sections received, with fuchsin and methylene-blue, in the central part of the necrotic foci, termed by Doerr and Zdansky granulomata, certain distinctive elements were observed. Similar "corpuscles" were subsequently found also in material obtained from rabbits, as a result of inoculation with other "strains" of alleged encephalitic virus, e.g., others of Kling, one of Koritschoner, from Vienna and a Basel virus. Into the history of these different strains it is not necessary to enter here. Doerr and Zdansky found the elements only in association with the necrotic foci, which they describe as being constituted mainly of cells of epithelioid and lymphoid character, with occasionally a few giant-cells. The corpuscles were either intracellular or else (apparently, from the authors' figures, more usually) free in large, cyst-like spaces, which were often about the size of a large nerve-cell. These "cysts" were sharply delimited, but did not possess any well-defined wall, manifest by any differentiation observable in the staining.

The elements themselves, after Ziehl-Neelsen staining, appeared violet to purplish, the tint varying slightly. They were also stained by Löffler's methylene-blue. But, according to Doerr and Zdansky, after staining with hæmatoxylin, the corpuscles either could not be recognized at all, or else were visible only as strongly refractile particles. In shape, they were ovoid or sickle-like, about 1·5 to 3 microns long, and they showed internally a

nuclear-like body, this being well marked after staining with methylene-blue.

Doerr and Zdansky came to the conclusion that these granulomata and the corpuscles bore no relation to the virus of encephalitis lethargica (v. Economo), but were due to an accidental disease of the rabbits. In their first notes, apparently, the authors were not at all convinced of the parasitic nature of the elements (*vide* Levaditi, Nicolau and Schoen [18]), but in their latest account (loc. cit.) they state confidently that they are not products of degeneration, but are to be regarded, in all probability, as organisms.

The results obtained by Levaditi, Nicolau and Schoen agree in the main with the above, but they have carried the subject much farther. These workers made use of rabbits affected with spontaneous encephalitis as well as others which had been inoculated with different strains of virus—Kling's, Thalheimers's or Twort's. The French workers note that the nodules or foci are often in part constituted by plasma-cells and large mononuclears, and some of the macrophages contain the parasites. In their opinion such cells have ingested the organisms, and certain of these intracellular forms are considered to show degenerative changes. In foci with marked necrosis, free or isolated forms occur, which have most probably been set free by the breakdown of an enclosing cell. Other epithelioid cells of these necrotic foci contain brownish pigment. The apparent "cysts," corresponding to the spaces of Doerr and Zdansky, are filled with parasites, from twenty to forty in number. There is sometimes an elongated nucleus closely applied to the cyst at one side. It is important to note that Levaditi, Nicolau and Schoen describe and figure cysts quite apart from any focal areas and with no particular cell-reaction at all noticeable in the immediate vicinity.

The French workers definitely assign the parasite to the Microsporidia (Sporozoa) and have given it the name of *Encephalitozoon cuniculi* [13]. They distinguish various phases, which they term pansporoblasts, sporoblasts and spores. Both sporoblasts and spores stain readily by Mann's method, after fixation by the method of Bouin-Brasil, appearing a strong red colour; they also stain with a mixture of eosin-orange and polychrome methylene-blue (Unna). But after staining with Giemsa, or by Laveran's panchrome method, following fixation in absolute alcohol, only the young forms, the sporoblasts, are stained.[1] The spore-membrane appears impermeable to these stains, as also to iron-hæmatoxylin. But after prior treatment with HCl the spores are found to stain with iron-hæmatoxylin. The French workers found that the spores are not acido-resistant.

As regards the details of structure, the authors consider that the cysts, which may be oval or spherical, are limited by a definite membrane and

[1] I have found no difficulty in staining the spores with Giemsa (*vide* General Discussion, below).

show one or two flattened nuclei applied to the outside. The cyst may attain the size of a large pyramidal cell (twenty to thirty microns). Such a cyst may contain a large number ("incalculable") of parasites, i.e., spores. The spores are usually oval or pyriform in shape. They show a definite membrane and contain a mass of chromatin, situated either at the centre (somewhat laterally) or near one of the extremities. Thus the appearance is obtained of a clear round space, or vacuole, which separates the chromatin from the membrane at one pole. This space, I infer, is taken to represent the polar capsule of a microsporidian; but nothing is said as to any character of refringence exhibited, which is a marked feature of a true microsporidian spore—often, even, when fixed and stained. Further, it may be noted that no reference is made to any cytoplasm, or to the amœbula, as such; and, moreover, from the authors' text-figures, there seems to be a remarkable irregularity and variability in the structural details of the spore. Finally, it must be confessed that no definite indications are given, either from the authors' description or from their admirable figures, of any developmental sequence such as would be implied by the use of the well-recognized terms—pansporoblast, sporoblast and spore. Solely in one very doubtful instance (text-fig. 14) are a number of pansporoblasts, in the form of a nodule or clump, figured. And this nodule is vastly greater than the size of a large (separate) spore-containing cyst shown in the same figure. If the pansporoblasts figured all gave rise to spore-containing cysts, there would be such a mass of these as has never yet been found. Personally, I am of the opinion that the "pansporoblasts" figured are epithelioid cells comparable with those shown in the centre of many of the nodules (e.g., in their text-fig. 3). Apparently, the spore may itself undergo binary fission, of somewhat unequal character.

Isolated spores appear quite similar. But an important point is that such spores are stated to undergo involution. Many of the cysts are considered to become ruptured, as a result of the leucocytic reaction around them; and the individual parasites (spores) are engulfed by macrophages, gradually degenerate and ultimately disappear. On the other hand (as Doerr and Zdansky described, loc. cit.), separate spores, of quite normal appearance, may be present in the centre of necrotic foci; this is a fact somewhat difficult to understand on the French authors' view.

Levaditi, Nicolau and Schoen give a good account of the occurrence of the parasites also in the kidneys. The lesions affect the capsule, papilla, cortex and medulla, and it need only be remarked that they are of similar character to those in the encephalon. The parasites are present in the epithelial cells of the renal tubules, forming cysts of varying size with a very variable number of spores. This is regarded as the normal situation in the kidney. Ultimately, the cysts burst, and the spores are set free into the lumina of the canaliculi and so pass to the exterior with the urine. But, just as in the case of the brain, separate spores may be found in the centre of focal lesions, amongst epithelial and leucocytic debris. Here, too, the spores are seen in involutive and degenerative forms.

More or less concurrently with the Swiss and French work above outlined, several interesting and important observations have been made by American workers and also by two Italians, Verrati and Sala; the papers by the last-named I have, unfortunately, not been able to see. Among the American and Canadian workers who may be mentioned are Cowdry and Nicholson, Goodpasture, McCartney, Cameron and Maitland and Smith and Florence.

McCartney's account [24] is concerned chiefly with the brain-lesions in stock laboratory rabbits. These were of the usual order, but the surprising feature is that they were observed in more than half the animals examined, namely, in 55 per cent of 372 rabbits, and the lesions were marked in 47 per cent. The animals were mostly, to all appearance, healthy, but some had snuffles, while others were dying from the effects of certain infections or experimental procedures. The lesions are classified as perivascular, meningeal, cerebral, or in connexion with the ependyma of the lateral ventricles; most of these types could be met with, very often in the same case. McCartney describes the lesions as being formed mainly by the infiltration of cells of large mononuclear type. The incidence of the meningo-encephalitic changes varied; in supposedly normal rabbits, and in certain others, the percentage was from 40 to 60; in those suffering from diseases like pneumonia, septicæmia, it was 70, and in those afflicted with snuffles a percentage as high as 76 was noted. I think it is worth pointing out that McCartney makes no reference to the observation of *Encephalitozoon* himself, though he alludes to the discovery of this organism; nor do any of his numerous excellent figures of the lesions show the least indication of them. However, McCartney states that Cowdry was able to find the parasites in some of the particular brains of the above material, which had been placed at the latter's disposal for this purpose.

Similarly, Goodpasture [11] found the lesions in ten out of thirty-three rabbits bought from local dealers, and also in others which had been infected with the virus of herpes simplex. The lesions were irregularly distributed throughout all parts of the brain, and were also found in the kidneys and lungs—this last observation revealing another site. In all these organs the parasites could be found. This worker considered the organisms to be Gram-positive and also slightly acid-fast. He admits that they may represent a stage in the life-cycle of a protozoan parasite, but is much more inclined to regard them as being of bacillary nature. Goodpasture considers the encephalitic condition to indicate a generalized infection, but apparently does not agree with Twort and Archer's view that it is due to a filterable virus. The organisms are regarded as being the same as the *Encephalitozoon cuniculi* of Levaditi, Nicolau and Schoen.

The first indication of any different stage or phase of the parasites which might point to the occurrence of a definite life-cycle of protozoan type is to be found in the observations of Verrati and Sala [29], which

I have abstracted from the review by Da Fano [7]. The parasites were noted in one of two rabbits inoculated subdurally with a passage-virus of Kling, thought to be encephalitic; and this same rabbit showed the characteristic infiltrative changes. The organisms occurred in the brain, medulla and spinal cord, and were not in the form of cysts, containing numbers of separate elements (spores), but appeared as round or oval bodies, from twenty-five microns up to as large as sixty microns in diameter. Most of these bodies consisted of a thin, structureless membrane and a protoplasmic mass, with distributed chromatinic particles. Occasionally, the mass was not of this plasmodial character, but was formed of many spindle or pear-shaped portions, each with a chromatinic granule. In such a case, of course, the bodies showed a considerable resemblance to the cysts of other workers, and could be regarded, indeed, as cysts containing organisms or spores very closely packed together. Hence, Verrati and Sala came to the conclusion that the large plasmodial bodies were only a different stage, i.e., a somewhat earlier condition, of the same parasite, *E. cuniculi*. Verrati and Sala found that this form of the parasite stained quite well with Weigert's hæmatoxylin, followed by van Gieson.

A similar stage and, in addition, certain other features have been noted by Cameron and Maitland [4] and described and well figured by Da Fano [6], who made use, largely, of material presented by Maitland. The Canadian workers first observed the parasites in sections of the brain of a rabbit of the third passage of the virus of a non-typical case of human encephalitis. And the organisms were found regularly in the case of all rabbits that died as a result of subsequent passages. (A consequent re-examination, both of the human material and of the brains of rabbits of the first two passages, proved, however, quite negative.) In the positive material, Cameron and Maitland found the parasites to be usually abundant in the fore-brain, and particularly in the neighbourhood of the ependyma of the lateral ventricles, where infiltration was very marked. Careful attempts were made to find the organisms in the blood, but without success; and blood inoculated intravenously into healthy rabbits failed to transmit the infection—a very interesting point.

Da Fano (loc. cit.) states that preliminary bleaching with H_2O_2 or by the Pal method facilitates the staining of the parasites. But Cameron and Maitland found no difficulty in staining the parasites (after fixation with formalin) by any of the customary methods (e.g., methylene-blue and eosin, Giemsa, hæmatoxylin and eosin) without such preliminary bleaching; and I may mention here that neither have I myself found this at all necessary.

The forms occurring in Cameron and Maitland's material are apparently of similar type to those described by Verrati and Sala, and certainly do convey a slightly different impression when compared side by side with the forms of Doerr and Zdansky, Levaditi, Nicolau and Schoen, etc. In

addition to plasmodial masses of varying size, different stages in the separation of the contents into individual elements, each containing a single, small nuclear body, are readily found. Many aggregations of the parasites are found definitely in cells, which are regarded as distended macrophages, the cell-nucleus being frequently visible. The parasites, it is considered, had presumably been ingested by these macrophagic cells. From the figures, such forms do not appear, however, to have undergone degeneration, or, indeed to differ in any way from those in the cysts. It is important to note that Da Fano mentions and figures the occurrence of the organisms actually in nerve-cells, thus confirming Wright and Craighead's original observation.

The outline of the apparent cysts is not always regular, depressions in the side or bulging processes like buds being at times noticed. Another fairly common shape found was that of a slightly bent oval. As a rule, a well-defined membrane encloses the cyst; sometimes this membrane appears somewhat shrunken, or even ruptured. From this fact, and the frequent occurrence of isolated corpuscles (parasites) in the surrounding tissue, the conclusion is drawn that the cysts, having attained a certain size, may burst, liberating the enclosed organisms. As had been observed by other workers, the cyst was often noticed to have a nucleus "moulded on its external surface." Da Fano points out that such an appearance is to be explained by the fact that in such cases the membrane is not a true cyst-wall, but merely the remains of the cytoplasm of the greatly distended macrophage enclosing the parasites. Some of the groups or clumps are very small, containing only four to six or more organisms. These also are delimited by what appears to be a very delicate capsule. Such groups are generally found in the immediate zone of dilated and infiltrated blood-vessels.

The size and shape of the corpuscles vary to some extent, both in the cysts and in the case of solitary forms. They are usually about one to two microns in diameter and round or slightly oval in form. They have not such a uniform, elongated and narrow shape as the elements in the cysts described by the Continental workers, and this different aspect in the two cases I can already corroborate from my own observations. The nuclear granule, or small body, which is markedly basophilic, generally lies near the centre, but sometimes it is situated near to one end. The cytoplasm usually stains uniformly, but occasionally in larger individuals, where the nuclear body is eccentric, a clear area or vacuole is visible in the middle. Both Cameron and Maitland and Da Fano consider the parasite as probably belonging to the Sporozoa; but the latter adds that the opinion of Levaditi, Nicolau and Schoen that it is a Microsporidian cannot be shared without further investigation—which is, I think, a very wise reservation.

(*To be continued.*)

(*References and Explanation of Figures will be given in the July No.*)

MEDICAL STATISTICS.

By A. M. D. 2.

Many say whole-heartedly and with some force of expression, "Confound statistics." They look with suspicion on this subject, as the well-known platitude that "figures may be made to prove any proposition" is ever present in their minds. The statistical branch of the Army Medical Services view the actual statistics they prepare with impartial minds. They realize, however, that there is a human side to the Army statistical forms prepared and sent in by medical officers. This human side is apt to be lost sight of, and many officers view the work entailed in completing these forms as only a dull routine part of their duties. Understanding and interest can only be enlarged and stimulated by knowledge.

To disseminate knowledge by writing an article on statistics is a task not lightly undertaken, and this article has only been compiled in response to the request of officers for help in their difficulties.

The statistics published in the Annual Report on the Health of the Army up to 1914 were compiled from the now obsolete Army Form A 32, rendered yearly by the military hospitals. This form contained the detail of diseases for which officers, other ranks, women and children were admitted to hospital. The card system was adopted for post-war years, and it is the one we are now going to review.

A specimen Hospital Case Card (Army Form I 1220) is shown on page 412. It is completed for every case admitted to a military hospital or military families hospital, whether the patient is on the strength of the Army or not, and for each military patient admitted to a civil hospital. Part I is completed by a clerk in the hospital office, Part II by the medical officer in charge of the case. (See next page.)

On the patient leaving the hospital on discharge to duty, as an invalid, by death, or transfer to another hospital, the card is forwarded to the Under Secretary of State (A.M.D. 2), War Office, the officer commanding the hospital being responsible that the card is complete in all the necessary details before it is despatched.

A card is also completed and sent to the War Office for every officer and soldier in the military command who dies *out of hospital.*

The Hospital Case Card is perhaps the most important of all our medical records. It is the basis on which all medical statistics relating to the health of the Army are founded; it is very useful for research purposes, and as a medical record of an individual it is of great value to the Director-General in assisting him to form an opinion when considering claims for disability pensions.

On receipt of the card at the War Office it passes through the following stages:—

(1) The serial number in the admission and discharge book is checked.

CONFIDENTIAL. Army Form I. 1220.

HOSPITAL CASE CARD to be completed for every patient admitted to a military or military families hospital.

Part I.

Station....................

Hospital.. Serial No. in A.D. book..................

Regt. or Corps .... *For War Office use only.*

Surname and Christian Name ....

Army No...............Rank...............Age.........Service..................

Date of admission or transfer to hospital.......................................

If a transfer state name of hospital from which transferred ....

Date of discharge (*a*) to duty.............. (*b*) as an invalid..............
(*c*) by death.............. (*d*) by transfer..............

If transferred, state name of hospital to which transferred ....

No. of days under treatment (including dates of admission and discharge) ....

Part II.

To be filled in by Medical Officer in charge of the case.

(1) Disease or injury ....

(2) New disease supervening..

(3) Date of onset of new disease...

Operation (nature and date)..

Condition of patient on admission :—

N.B.—Patients' names and diseases should be entered in BLOCK letters.

In the event of an error in diagnosis, the disease or injury entered will be crossed out in such a way as to remain legible, and the new disease or injury will be entered above it. In the event of a new disease supervening it will be entered under (2).

REVERSE SIDE.

Notes on previous history of patient, and family, if relevant:—

Notes on movements of patient, if relevant:—

Notes on treatment and progress of patient:—

State whether Army Form I. 1237 (Medical Case Sheet) has been completed.

Result of Laboratory or P.M. examination (if any):—

Signature of Medical Officer.....................................

Rank.

Date........................

NOTE.—A similar form—R.A.F. Form 39—is used in the Royal Air Force and in order to simplify the completion of these cards and increase their value as permanent records, it has been decided that the headings on A.F. I. 1220 and R.A.F. Form 39 shall be identical.

(2) The card is then reviewed to see that the various headings have been completed correctly.

(3) The card is next passed to a clerk who "codes" the disease or injury, checks the number of days under treatment, and examines the remarks on the case to see that they are not contradictory, and to mark any item of probable importance.

Should the patient have been transferred from another hospital, the transfer cards are linked up to the card showing the original admission to hospital, so that the records relating to the one admission are brought together.

The majority of the diseases shown in the Nomenclature of Diseases have been given a "code" number. The numbers begin at 1000 and run consecutively upwards to 3250.

In the more important diseases, where it is necessary to record the different varieties, the latter have been given a distinct code number, for instance:—

1051 malaria.

Varieties: 1052 quartan, 1053 benign tertian, 1054 subtertian, 1055 malarial cachexia.

It will thus be seen how very necessary it is that medical officers should enter on the Army Form I 1220 the variety of any particular disease from which the patient is suffering.

Each military hospital is also known by a code number. In this instance the code number begins with 1.

If the entries on the Hospital Case Card are all in order, the coding clerk enters certain details from the card on to a "Statistical Card," a completed specimen of which is shown on pages 415 and 416.

Every Command has a separate statistical card for each disease or variety of disease bearing a code number in the Nomenclature of Diseases.

The hospitals at which the cases occurred are denoted by the code number for the hospital shown at the side of each entry. Supposing that the Hospital Case Card received by the coding clerk referred to a case of influenza (code number 1039) at Colchester, he would take the statistical card for the Eastern Command bearing the disease code number 1039 from his file of cards, or if it should be the first case of influenza for the year, he would prepare a new card.

Under the column HOSPITAL he enters the figure 9, which is the code number for Colchester. Under the column DAYS he enters the number of days the case was under treatment. Under the column AGE he enters the patient's age, and under the column SERVICE his length of service.

Should the patient be discharged the Service, or die as the result of influenza, a stroke / is made in the appropriate column on the back of the card.

In the case of a Command overseas, where the patient is sent to the United Kingdom as an invalid, this is denoted by a stroke in the special column, INVALIDS SENT HOME.

Year 1923 **Command Eastern** **Disease or Injury 1039**

Hospital	Days	Age	Service	Hospital	Days	Age	Service	Hospital	Days	Age	Service	Hospital	Days	Age	Service	Hospital	Days	Age	Service	Hospital	Days	Age	Service
20*	**R 4**	**22**	**5/12**	8	9	23	4/12	10	10	22	2/12	14	13	22	2	21	20	22	4	15	12	19	2
20	6	18	4/12	8	21	33	12	10	13	20	1	14	26	16	1	21	23	20	2	15	13	21	4
20	15	22	1	9	7	23	4	10	9	20	1	14	4	21	4	21	35	23	5	15	24	20	2
20	6	18	1/12	9	14	33	8	10	10	20	3	14	9	22	4	21	R 9	21	3	15	16	18	1
20	6	41	16	9	14	19	2/12	10	20	19	1	14	10	22	4	21	16	20	1	15	R 9	24	6
20	9	18	3/12	9	14	18	2/12	10	13	18	1/12	14	1	22	4	21	5	37	21	15	9	29	10
20	8	21	3/12	9	14	19	2/12	10	12	19	1	**15**	**20**	**22**	**4**	**17**	**5**	**37**	**21**	15	11	20	2
20	6	23	3/12	9	24	18	4/12	10	13	21	1	14	R 1	22	4	21	5	18	1	15	7	21	4
20	7	19	3/12	9	13	20	2/12	10	25	26	5	**15**	**38**	**22**	**4**	**17**	**5**	**18**	**1**	15	14	18	1
8	35	20	1/12	9	13	18	3/12	10	R 7	26	4	14	2	21	4	21	4	19	5/12	15	10	20	4/12
8	10	15	1	9	13	18	1/12	10	7	17	2	**15**	**12**	**21**	**4**	**17**	**19**	**19**	**5/12**	15	12	19	1
8	14	23	1	9	18	19	3/12	10	R 7	23	5	14	1	21	4	21	24	20	6	15	R 8	24	9
8	16	23	5	9	13	18	2/12	10	13	19	1	**15**	**12**	**21**	**4**	21	24	19	4/12	15	11	24	6
8	8	17	3	9	13	19	2/12	10	10	15	1	14	5	19	2	21	50	23	4	15	8	19	4/12
8	14	32	8	9	13	21	2/12	10	10	22	1	**15**	**7**	**19**	**2**	21	19	19	4/12	15	15	19	8

Total admissions = 156 **Relapses = 14** Total number of days = 2,415

* Heavy type represents red ink.

Hospital	Days	Age	Service	Hospital	Days	Age	Service	Hospital	Days	Age	Service	Hospital	Days	Age	Service	Hospital	Days	Age	Service	Invalids sent home		Invalids finally discharged					Deaths	
10	26	19	2/12	23	9	21	1/12	17	R 9	18	1/52	11	10	19	1	7	8	21	3	1	1	1	1	1	1	1	**1s**	1
10	12	15	1	23	4	20	2	17	8	18	1/52	11	7	22	4	7	6	18	1/12	1	1							
10	22	20	1	23	9	23	3	17	R 8	19	3/12	11	6	21	4/12	7	12	22	4	1	1							
17*	**52**	**20**	**1**	23	5	15	1	17	42	29	2	12	1	21	6	7	1	18	3/12	1	1							
10	9	26	9	23	11	20	6	17	R 13	18	3/12	**8**	**22**	**21**	**6**	**15**	**10**	**18**	**3/12**	1	1							
10	5	23	2/12	**21**	**53**	**20**	**6**	17	R 31	26	2/12	12	23	18	5/12	7	1	28	9	1								
10	18	19	1	23	2	20	1	17	50	19	1	12	13	23	4	**15**	**24**	**28**	**9**									
10	6	18	1	23	9	23	2	17	9	25	1/52	12	8	29	6	7	3	28	9									
17	**18**	**18**	**1**	23	13	28	3	17	**5**	22	2/52	12	18	18	5/12	7	17	28	5									
10	1	23	4	23	7	19	5/12	17	R 15	23	3	12	8	18	5/12	20	15	19	4/12									
17	**29**	**23**	**4**	23	5	19	4/12	17	27	23	1	12	R 8	21	3	20	11	20	2/12									
10	R 1	19	1	**17**	**10**	**17**	**1**	17	9	21	1	12	12	19	1	20	8	20	3/12									
17	**7**	**19**	**1**	**17**	**5**	**19**	**5/12**	17	15	22	2	12	24	25	11	20	9	21	1/12									
11	**5**	**20**	**3**	**17**	**11**	**18**	**1/12**	17	12	24	4	12	15	37	17	20	R 1	18	5/12									
11	1	21	**3**	17	4	25	10	17	18	17	3/12	12	7	22	1	20	11	20	1/12									
15	**105**	**21**	**3**	17	**12**	19	2/12	17	13	17	1	12	17	18	4/12	20	18	18	1/12									
11	6	22	**4**	17	22	23	10	17	17	18	3/12	**13**	**8**	**18**	**3/12**	**21**	**35**	**18**	**1/12**									
11	**7**	**21**	**4**	17	15	19	1/52	17	6	18	2/12	13	4	18	1/52	20	12	21	3	11		5					**2**	

* Heavy type represents red ink.

The above entries are made in *black ink* if they refer to a direct admission to the hospital concerned, but are entered in *red ink* if they refer to a case transferred from another hospital, or to one remaining in hospital from the previous year.

In the case of a death by suicide, a capital S is entered by the side of the stroke in the death column, and in the case of an admission for a relapse of disease a capital R is entered against the number of days entered in the DAYS column.

After the Army Form I 1220 has been dealt with statistically, it is filed and can be referred to whenever any question connected with the individual arises. The system of filing which has been adopted is as follows:—

OFFICERS	Alphabetically for the whole of the British Army
OTHER RANKS	Alphabetically by Regiments and Corps
MEMBERS OF THE NURSING SERVICE	Alphabetically as a whole
WOMEN ON MARRIED QUARTERS ROLL	Alphabetically for the whole of the British Army
CHILDREN ditto	ditto
TERRITORIAL ARMY	Alphabetically
ROYAL NAVY, PENSIONERS AND FREE PATIENTS	Alphabetically irrespective of rank or section
CADETS AND BOYS OF MILITARY SCHOOLS	Alphabetically irrespective of school
WOMEN NOT ON MARRIED QUARTERS ROLL	Alphabetically as a whole
CHILDREN ditto	ditto
ALL OTHERS NOT INCLUDED IN ABOVE	Alphabetically as a whole

Should any medical officer, therefore, desire information on a patient's previous admissions to hospital, or wish to write an article on the cases he has treated, he can obtain from the War Office, through the officer commanding the hospital, any Army Form I 1220 submitted subsequent to the end of September, 1921. All applications for cards must state the Army No., Rank and Name, and the Regiment, of the individual whose card is required.

Army Forms I 1220 are coded and filed as they are received, the statistics thus being kept up to date. At the end of each year, when the "remained" cards, i.e., for cases remaining in hospital, are received, the statistical cards are completed as follows:—

The number of separate entries in *black ink* only under the column headed DAYS are added up. This gives the total number of admissions for the disease indicated by the disease code number in the specified Command for the year.

The figures under the column headed DAYS in both *black and red ink* are then added: these give the total number of days patients were in hospital, and by dividing this figure by the number of days in the year we obtain the average number constantly sick.

By counting the number of strokes in the columns headed: INVALIDS SENT HOME, INVALIDS FINALLY DISCHARGED and DEATHS, the numbers of such for the particular disease are obtained.

The statistics of any particular hospital are obtained by adding only those sets of figures which are opposite the code number of the hospital in question.

In preparing the Annual Report on the Health of the Army, the "totals" on the statistical cards are typed in tabular form, the diseases being grouped in the same order as they appear in the Nomenclature of Diseases. The form is headed:—

YEAR
and
COMMAND,

and shows the Average Annual Strength (which is obtained from the monthly strength issued by the Adjutant General), together with the actual number of Admissions, Deaths, Invalids sent Home, Invalids finally Discharged, and Number of Days under treatment for each disease.

The particulars on the tabular form are again condensed into the form which ultimately appears in the Annual Report on the Health of the Army.

For the system at present in use it is necessary that the Hospital Case Cards should be received at the War Office complete and accurately filled in. Co-operation is essential, and while we in A.M.D. 2 endeavour to rectify as many errors as possible, the department was very reluctantly forced during 1923 to return 454 cards for correction to command headquarters in the United Kingdom alone, and to write for 518 cards which had not been rendered.

The most common faults are:—

PART I.

(1) The omission from the card of the Serial No. in Admission and Discharge Book.

(2) The duplication of the Serial No. in the Admission and Discharge Book.

(3) The omission of Age and Service.

(4) The omission of the name of the hospital from or to which the patient was transferred.

(5) Showing a patient as discharged "to duty" when the remarks on the back of the card state that he was discharged "as an invalid."

(6) The cards for infectious or other cases transferred to civil hospitals for treatment are rarely dealt with as laid down in the Regulations for the Medical Services of the Army.

(7) The most frequent error of all is the wrong computation of the number of days under treatment.

PART II

(1) Illegible handwriting which cannot easily be deciphered.

(2) Omission of the name of the disease or the use of disease-names which do not appear in the Nomenclature of Diseases.

(3) Lack of detail, particularly as regards the previous history of the patient.

By attention to detail we can reduce this margin of error, diminish a minor irritation, lessen our work and benefit the taxpayer.

We would emphasize the important fact that Hospital Case Cards, in addition to forming the basis for statistics regarding the health of the Army, are frequently examined in connexion with claims for disability pensions. Their value in this connexion depends solely on the manner in which they are compiled by the medical officer in charge of the case. He should bear in mind that the award of a pension to a disabled soldier or a soldier's widow may hinge on the completeness and accuracy of his notes, which, at the same time, should safeguard the interests of the State by enabling undeserving claims to be disallowed.

THE CORRESPONDENCE CIRCLE.

BY MAJOR M. B. H. RITCHIE.
Royal Army Medical Corps.

VI.

WANTED: A VIGOROUS FORWARD POLICY IN HYGIENE.

I.—*The Verdict of History.*

A POINT regarding war in the early twentieth century, that may intrigue the "Slant-eyed historian of the future"—to use a phrase of Sir Ian Hamilton's—is the slow development of hygiene in its application to armed forces in peace and war. "Here is a science," Slant-eyes may argue, "of vital military importance, that gives high commands opportunities which never occurred before, and enables them to carry out successful campaigns in theatres of war where troops once melted away from sickness, and yet—this branch of the art of war developed tardily. No soldier of the early twentieth century, apparently, possessed vision enough to exploit hygiene, though the military literature of that epoch recognized that the science had a military value; schools of thought appear to have been reactionary enough to relegate hygiene to a secondary place in war efficiency. The twentieth century generals must have known for three decades what hygiene was capable of doing; they had much experience of war, including the Great War, but they were content to fight with a large proportion of their personnel in hospital from preventable disease. Truly, this lack of vision beats me."

II.—*The Secret of Military Success.*

The future historian, be the angle of his orbits what it may, will indeed express surprise at the slow development of hygiene, for it is remarkable. Armies, and the brains that govern them, are popularly supposed to be reactionary, more so in peace than in war; consequently, the great commanders of history have usually gained their victories by making use of novel methods; they have thought out something new, taken their opponents by surprise, and overwhelmed them. At intervals through history one clever brain, or a combination of clever brains co-ordinated by one man, has speeded-up the art of war rapidly, gained great victories, and altered the map of the world. It is probable that some clever brain may repeat this performance by employing new-born agencies of destruction, coupled with the middle-aged agency of life preservation; he may win his battles through saving the enormous wastage that preventable disease has hitherto inflicted upon armed forces.

III.—*The Wide View.*

It is now time that the medical service began to think big on this question of advancing the science of hygiene in relation to armed forces in peace and war, and to think big, one has to develop the faculty of viewing problems in their broadest aspect. One is inclined to limit the scope of one's thoughts and ideas to what are the details of this science, and see it only in the narrow field of peace-time problems in a nucleus army. Also, one may be inclined to run away with the idea that it is a science dealt with only by the specialist. We have got to stand right away in order to get the wide perspective, viewing hygiene in relation to the armies and navies of the world, and to imperial strategy and defence. The mind of the medical man tends towards limitation of perspective, because he is dealing with a subject that requires to be split up into special partitions, and he is never taught to cultivate the wide views of things.

IV.—*The Big-Job Man.*

Some men are specially endowed by Nature to tackle the greater problems of organization and administration, whether in commercial, political or military life. They form a type called the "big-job man," that usually finds in business the scope for its abilities. The big-job mind, however, can be cultivated; it can be created by teaching and by experience of big-job work, and it ought to be acquired by the medical man. Some of its composition comes from moral courage, much from horse-sense, and little from a mental repository stuffed with petty details. One big-job quality is the power to pick out the main essentials of a great problem; another is to know what is secondary and leave it out of the picture; a third is concentration on the things that really matter; a fourth, a sense of the true proportion of things; a fifth, determination to strike deep at the roots of everything unsound and futile—and so on.

V.—*Hewers of Wood.*

It is fairly obvious that military training and discipline do not help much in the acquirement of big-job mentality; subordination, attention to detail, undue prominence given to matters of minor administration, clerical meticulousness, correct channels of correspondence, are military virtues in their own way, but they do not tend to develop the wider conceptions. We have got to guard against viewing our duty wholly as a subordinate one, and leaving the big-job points to others; we must not reduce our outlook to that of mental hewers of wood and drawers of water. A cat may look at a king; so may a captain think as a colonel; though it may be that what are mere platitudes when voiced by captains, fall as pearls of wisdom from the lips of colonels. Nevertheless, mental capacity is not limited by age or by rank, nor does it possess shoulders upon which to

carry pips or other adornments; may the captain ever possess the mind of a colonel, not that of a corporal.

VI.—*The Building-up of a Great Policy.*

To return to hygiene, it looks as if the time is fast approaching when we shall have to sit down and try to think big about it. We may be suddenly called upon to formulate new policies, and state precisely what we want done in order to bring disease-prevention in peace and war up to a pitch where it will strike out from the sick returns the dirt diseases, dysentery, malaria, and the venereal diseases. Before we can give considered opinions, we must view the whole matter in the big-job way.

We should, therefore, have "cut and dried" a definite policy, with individual variations, one with which the majority of us will agree in all the main points. Sound opinions held by readers of the Journal should be collected, assessed, and built up into an unofficial hygiene policy. The reader should put himself in the position of one of the heads of a political party that intends to go to the country with an attractive, imaginative, and imperial programme, calculated to advance the interests of the Empire. In this frame of mind he should sketch out the main essentials of a vigorous, forward policy in hygiene—and let us have the results.

VII.—*Organization: Equipment: Training.*

In such a policy one might envisage the provision in peace time of much of the sanitary equipment required for war, from trivial articles like grease-traps to mobile laundries and disinfestors. It is unsound to await the outbreak of hostilities before considering equipment, when it may have to be got hastily in order to soothe popular anxiety. Then there is the big question of organization; whether the provision, construction, supervision and maintenance of sanitary establishments should continue under officers commanding units, with the medical officers advising them, or whether these matters might be dealt with by an expanded sanitary section, or an executive sanitary service. Again, there is the matter of disseminating sanitary knowledge; teaching the individual soldier by putting him through a definite course of sanitation, theoretical and practical, consisting of a number of lectures and demonstrations, held at every depot, and an annual refresher course. This might mean the formation of small teaching units, provided with sufficient equipment for demonstration purposes, and the expansion of the school of hygiene.

VIII.—*Facts to be Faced.*

The need for some "hustle" at the present moment is obvious, because we are tolerating partial success—and partial success is partial failure. Whether put into force or not, we have got to consider what measures should be taken in order to gain complete success. In the matter of

malaria, for example, the fact stares us in the face that though we know how it is spread, how best treated and how prevented, it is still a cause of much inefficiency in our own and other armies; this in spite of there being only a few malarial months in the subtropical year, in spite of large non-malarial areas, and with mobility revolutionized. With regard to venereal diseases, we are dealing with one of the most easily prevented group of diseases, in a moderately educated population, under discipline, yet we are tolerating a comparatively high incidence. We read our own manuals, but we seem to be prepared to go on service with water-purifying equipment for certain field units only, while we cannot make the essential camp sanitary appliances until material has been "scrounged." From a perusal of these manuals and regulations one might suppose that the soldier went through a course of sanitation, yet this seems to be limited to four lectures yearly, and a relatively small number of men attending the very excellent course at the School of Hygiene. Hygiene is taught, but not on an organized basis.

IX.—*Precept and Practice.*

The Manual of Military Hygiene bristles with sound doctrine, and in framing an advanced policy there seems no need to go beyond its precepts. Here are some extracts as examples:—

"The aim of army sanitation is military efficiency, and no subject which either directly or indirectly affects the health of the troops can be disregarded."

"It is necessary to take a very wide view of sanitation."

"Recent experience under active service conditions in the late war has shown the important part played by certain so-called minor complaints in reducing the striking power of an army in the field."

"The study of sanitation and the preservation of health is incumbent on every officer and soldier."

"Nothing can be more important than an adequate supply of good water to an army."

"Army organization provides a complete chain of responsibility for disease prevention from headquarters to the individual soldier. Every link in that chain is of importance and cannot be dispensed with. Training of all ranks in sanitation is therefore as necessary as in any other branch of military science."

There is, then, a sound official doctrine to work on. The problem requiring solution is how to bring practice up into line abreast of precept. It is best to admit that disease-prevention is a more difficult matter than is commonly supposed, and the attainment of a high standard means much expenditure of money and of thought. Anyone who has attempted to tackle the problem of wholesale fly abolition or mosquito destruction in a short time, will realize that an apparently simple task is in reality a matter of immense difficulty, involving considerable expenditure; few sanitary

undertakings are as simple and cheap as we are led to believe, if complete success is to be obtained, and in these primary conceptions of disease prevention, I think that we have never quite got away from the early pioneer period, when everything had to be done on the cheap, or left undone. This is where the big-job influence should make itself felt; we have already got big-job theory in almost every page of our manuals; what we want to develop is big-job practice.

X.—*The Old Argument.*

Again we have the answer that the War Office and the College will see to that, but anyone who has had experience of higher administration will realize that reforms can be admitted in principle, and shelved through lack of funds or a hundred other reasons. Remember the absence of motor ambulances at the commencement of the war. Our leaders must have behind them a solid consensus of opinion, and the views of one individual, however brilliant he may be, are less likely to be accepted than the considered opinions of a body of officers. I feel sure that the Directorate of Hygiene will give us its support. This Directorate has to be recruited, and it is from those who are striving to acquire the big-job mentality that it should obtain its recruits.

Post-Graduate Opportunities in Edinburgh.

At the University of Edinburgh there are three diplomas which can be taken, these being the Diploma in Tropical Medicine and Hygiene, the Diploma in Psychiatry, and the Diploma in Public Health.

(1) *The Diploma in Tropical Medicine and Hygiene* (*D.T.M. & H.Edin.*).

The course of instruction for this diploma is given during the Autumn Term (beginning in October) and includes:—

Tropical Medicine (seventy-two hours).
Senior Bacteriology (sixty hours).
Entomology and Parasitology (eighty hours).
Disease of Tropical Climates (Systematic and Clinical).

Any two of these subjects may be taken under extra-academical teachers recognized for the purpose, or at a recognized School of Tropical Medicine; and a candidate may be exempted from attending the courses on Diseases of Tropical Climates who has been engaged for a period of at least twelve months in the Treatment of Tropical Diseases in any Tropical or Sub-tropical country.

Candidates must be matriculated for the year. Examinations are held in June and December. Class fees amount to £20 9s. 6d., and the examination fees to £5 5s. The classes are held in the afternoons, with the exception of Medical Entomology and Parasitology, which is from 9 to 11 a.m.

(2) *The Diploma in Psychiatry* (*D.P.Edin.*).

Candidates must have held (*a*) a resident appointment for one year in an approved hospital for mental disorders, or, alternatively, (*b*) a six months' appointment as above, and six months' practical study of nervous diseases in a special or general hospital approved by the Faculty of Medicine, and have attended the following courses of instruction :—

Part I, Spring Term, commencing in January.

(1) Anatomy of the Nervous System (twenty hours).
(2) Physiology of the Nervous System (sixty hours).
(3) Pathology of the Brain and Nervous System (forty hours).
(4) Psychology, Lectures and Demonstrations (thirty hours).

Part II, Summer Term, commencing in April.

(1) Clinical Psychiatry (in Royal Mental Hospital) (about 100 hours).
(2) Clinical Neurology, including Psychoneurosis (about forty hours).
(3) Experimental Psychology (sixty hours).
(4) An advanced course in one of the subjects of Part I, including Advanced Bacteriology (about sixty hours).

Candidates must be matriculated for the year. They are not admitted to the second examination until they have passed the first examination. These are held twice yearly; the first part in March and July, the second in July and October. Examination fees amount to £6 6s. for each examination. The class fees for the whole course are £31 10s.

(3) *The Diploma in Public Health* (*D.P.H.Edin.*).

The course of study begins in October and lasts for a year. In the autumn and spring terms the courses of instruction are :—

(1) Chemical Laboratory work and Meteorology (four hours daily, one hundred and twenty hours).
(2) Bacteriology (one hundred and twenty hours).
(3) Advanced Public Health (seventy hours).
(4) Entomology (about eighty hours).
(5) Venereal Diseases, clinical and administrative (thirty hours).

In the summer term, commencing in April :—

(1) Administration of infectious diseases hospitals, etc. (sixty hours).
(2) Duties, etc., of a medical officer of health (sixty hours during three months).
(3) Sanitary Engineering (thirty hours).
(4) Tuberculosis, clinical and administrative (thirty hours).
(5) Medical inspection of school children (twenty hours).
(6) Infant welfare (twenty hours).

In the summer vacation there is a continuation of (2) (5) and (6).

The first examination is held in March and July; the second in

October and December. Candidates are not admitted to the second part until they have passed the first. The subjects of the first examination are :—

(1) Chemical Laboratory work and Meteorology.
(2) Bacteriology.
(3) Entomology.

These examinations are oral and practical.

The second examination consists of :—

(1) Sanitation, Epidemiology and Infectious Diseases (written and oral).
(2) Sanitary Law and Vital Statistics (written and oral).
(3) Public Health Administrative Work, including reports on dwellings, workshops, hospitals and sanitary schemes generally.

The fees are 6 guineas for the first examination, and the same for the second; for reappearance in each examination, 3 guineas, but for one subject only in the second examination, 2 guineas. Candidates must be matriculated for the year in which they appear for examination.

The total cost of the class fees is not stated in the regulations, but those classes shown in the programme of classes, namely, chemical laboratory work and meteorology, bacteriology, advanced public health, entomology and parasitology, venereal diseases, tuberculosis and sanitary engineering, amount altogether to £34 13s. There are other courses for which the fees are not given.

Instruction in all subjects can be obtained in the University, and candidates must study for two terms therein. One term may be taken under recognized extra-academical teachers, but fees for these classes shall not be less than for the University classes.

Any information required can be obtained from the Dean of the Faculty of Medicine, University of Edinburgh.

The Fellowship of the Royal College of Surgeons of Edinburgh.

Candidates for this examination must be over 25 years of age, and have been engaged in the study of their profession for two years after having become qualified. The petition for examination requires the signature of two Fellows, one of whom shall be resident in Edinburgh. Failing this, application may be made, through the Secretary, to the President's Council for permission to sit the examination, backed by testimonials and references, etc.

The examination consists of :—

(*a*) Principles and Practice of Surgery, including Surgical Anatomy.
(*b*) Clinical Surgery.
(*c*) One optional subject.
  (1) Ophthalmology.
  (2) Surgical Pathology and Operative Surgery.

(3) Laryngology, Otology and Rhinology.
(4) Gynæcology.
(5) Obstretric Surgery.
(6) Anatomy.
(7) Dental Surgery and Pathology.

The examinations in these optional subjects are clinical or practical as well as written and oral. The candidate has to give three weeks' notice of his intention to sit for the examination.

The fee amounts to £45; in case of failure to pass the examination, £10 is retained as examination expenses. Failure on three occasions prevents the candidate being again admitted to examination. The examinations are held quarterly, one day being required for the written portion, clinical and oral examinations being held on subsequent days. Examinations take place in January, March, July and September. Information can be obtained on application to the Secretary, Royal College of Surgeons, Surgeons Hall, Edinburgh.

"OVERCAME SOLDIERS ACCUSTOMED ONLY TO THE USAGES OF THE PAST."[1]

III.

"GAS" (CHEMICAL WARFARE) DEFENCE AND THE HEALTH SERVICE.[2]

PART II: A SUGGESTED SCHEMA FOR ITS PART IN A CHEMICAL WARFARE SERVICE.

By MAJOR H. S. BLACKMORE, O.B.E.[3]
Royal Army Medical Corps.

INTRODUCTION.

IN No. II of this series arguments were advanced for the place which it was considered the Health Service should occupy in a special C.W. (Chemical Warfare) Service if the best results for the Army as a whole were to be obtained. In this paper a detailed schema is given for the Health Branch of such a service, in the hope that it may interest some and rouse others to criticism, whether friendly or the reverse. It must be clearly understood that nothing more than the outlines of a nucleus are intended. After all, one must begin somewhere, and although it is quite obvious that for financial, political, and military reasons only a nucleus could be formed at present, that is no reason why the nucleus should not embody the general lines of future development. Indeed the very fact that it is recognized as a nucleus of something that must eventually grow makes it all the more important to get the first lines pointing in the right direction. It is for this reason that criticism of any sort would be welcome as indicating that interest has been stimulated, and thought given to the subject.

It is well recognized that the advance of *understanding* (knowledge plus training and experience) takes time, and although the steady growth of a C.W. Service beyond the skeleton herein suggested is visualized, it is quite impossible to foresee the detailed lines which the growth will follow. The general trend can be well imagined, but the details depend upon the rapidity and character of the development of aerial warfare and of mechanicalization, upon the finding of suitable new substances in this and other countries, etc. In fact, any attempt to look forward more than a few years carries one at once into the realms of imaginative fiction, and there is little

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[1] A quotation from W. Morris's "Napoleon," p. 205.

[2] As this article is the third of a series, the title "Health" in lieu of "Medical," suggested in No. I, is retained for the sake of the sequence of thought, except in those paragraphs which deal with the past or the present.

[3] As I am at present doing duty at the Chemical Warfare Experimental Station, Porton, I wish to avoid the possibility of misunderstanding and to state definitely that the views expressed in this paper are my own personal views, and are in no way either "official" or "inspired."

incentive to invade a province so full of pitfalls whilst there is so much solid ground to be found, surveyed, and mapped out by a consideration of "the devils we wot of."

In order to present as complete a picture of the subject as space, and your patience, will permit, it is proposed to give a very short précis of the past and the present, and to end with the schema which forms the title and object of this paper. In this way it is hoped to present, in a logical sequence, the lines of observation and thought which have led me to the formulation of my suggestions. This question of the broad lines of organization of a C.W. Service is part and parcel of the general and particular views expressed in Parts I and II of this series and should be read in their light.

THE PAST.[1]

At the time of the inception of Chemical Warfare in April, 1915, the Army and the Nation turned to the Medical Service for help. This was a natural and instinctive action, and displayed the unerring clarity of thought so usual in such cases. For some time our whole conception of C.W. was expressed in the one word "Defence," and during this period the control was vested in the Medical Service, although the usual anomalies, inseparable from the present organization of the Medical Service, were already creeping in, and the ultimate responsibility for "Gas Defence," as it was called, rested with the Adjutant-General's branch.

The next step was the institution in March, 1916, of a "Directorate of Gas Services." This Directorate was divided into two branches, A and B, and to B branch (the Defence branch) was appointed an officer of the Corps primarily concerned with such matters by definition and by training—the Medical Corps. Here then we see some glimmerings of logic and clear thinking, but a reference to the History of the War [1] will show that there was even now some slight fog, and the small bright light of common sense was quickly put out.

In July, 1917, the post of A.D.G.S.(B) was taken from the Medical Service and a Chemist was appointed instead, a Physiologist being attached for liaison. After this the Medical Service were not (theoretically) concerned in any way with "Gas Defence" beyond their own units and the treatment of cases.

This was the guiding principle which persisted throughout the rest of the War, and which has coloured and directed the trend of thought ever since. It is not suggested in any way that the Directorate was anything but efficient and successful, but it is maintained that it was in spite of an ill-conceived organization; that there is a better and more logical organization; and that the inherent anomalies, resulting waste of energy, and failure to reach the highest possible pitch of efficiency are

[1] The statements in this section refer to the organization in France. The Medical Service at the War Office was responsible for ante-gas defence and for the provision of ante-gas appliances for all war areas from April 1915 until Oct. 1917, when the Ministry of Munitions took over anti-gas work.—ED.

still with us. The "God of things as they Are" is still triumphant over the "God of things as they Might-be."

The following diagram is of the Directorate as then constituted :—

- Director of Gas Services
  - Offensive
    - Asst. Dir. Gas Serv. (A)
      - Spec. Brigade R.E.
  - Defensive
    - Asst. Dir. of Gas Serv. (B)
      - Physiological Adviser to maintain liaison with Med. Service. Information about Gas Casualties
      - Army H.Q.
        - Chemical Adviser
Asst. Chemical Adviser
          - Commandant, Army Gas School. Two day courses for Staff and Senior Reg. Officers
          - Corps H.Q.
            - Chemical Adviser
              - Commaudant, Corps Gas School. Weekly courses for Officers and N.C.O.'s
              - Div. H.Q.
                - Div. Gas Officer
      - H.Q. L. of C.
        - Chemical Adviser
Asst. Chemical Adviser
          - Base Schools
  - Central Lab.

THE PRESENT.

After the War, Chemical Warfare suffered an almost total eclipse. The cause of this is not far to seek. It is due to the combination of many factors, not the least of these being the general opinion of the whole matter produced and fostered by the Press propaganda of 1915. When the Germans first took advantage of a weapon which was admirably suited to their needs—how admirably suited and how powerful they, luckily for the Allies, did not foresee—our surprise and consternation were partially counteracted by a vigorous, and probably inspired, campaign by the Press. This writing up of the subject, which aimed at a full description of the worst horrors of this new weapon so as to fan the wrath of the nation and to bring into sharp relief the heroism of our troops, was discontinued after a short while for equally obvious reasons, so that the first impression has remained to this day, a sort of pious horror of Chemical Warfare as a specific entity totally at variance with fact, but widespread, strong, and very difficult to eradicate.

A second factor of importance was, and still is, the attitude of the Mind Military (in which of course the Services are included) towards any

innovation, especially ones which threaten to demand the replacing of peaceful retrospection by active and anticipatory New Construction. Of such an iconoclastic nature are Tanks and Chemical Warfare, and the attitude of mind is well exemplified by the remark of a certain Senior Officer, who is reported to have said on hearing that the Armistice was signed, "Thank God! now we shall be able to get back to some real soldiering" [2].

Either or, perhaps, both these factors played their part in the production of the famous Washington Conference, but such Conferences and Agreements are notoriously ineffective when faced with the hard facts of a war-in-being, and in this connexion it may be of interest to quote from the speech of Admiral Mahan, the American representative at the Hague Conference of 1907, when a similar undertaking was arrived at and agreed to by most of the delegates. He said [3] :—

"The objection that a machine of war is barbarous has always been raised against new weapons, which were nevertheless finally adopted. In the Middle Ages it was firearms which were denounced as cruel. Later, shells, and more recently, torpedoes have been denounced. It seems to me that it cannot be proved that shells with asphyxiating gases are inhumane or unnecessarily cruel machines of war, and that they cannot produce decisive results. I represent a people that is animated by a lively desire to make warfare more humane, but which may nevertheless find itself forced to wage war; therefore it is a question of not depriving itself through hastily adopted resolutions of means of which it could later avail itself with good results."

The realization of the fundamental truth of such observations, coupled with the necessity for research, training, and practice, in order to be able to grasp and to foresee and forestall possibilities, kept chemical warfare alive as an unavoidable integrant of war.

These mutually antagonistic interests have produced, as the resultant of a "pull devil, pull baker" atmosphere, the peculiar conglomerant we have to-day. A diagram of that part which directly affects the Medical Service of the Army follows, and to grasp the true inwardness of the situation it must be remembered that the official watchword is *defence.*

Very little thought or perspicacity is required to see that this embodies not only all the old objections but some brand new ones as well, for it gives no systematization of control at the central point, the War Office, but an indefinite admixture of many branches, with the usual anomalies which come from those having *de jure* responsibility being vested with control and executive authority instead of those having *de facto* responsibility. This curious result arises from the latter having what is euphemistically known as "advisory responsibility."

The scheme also perpetuates the divorcing of "Ways" from "Means" and the violation of the cardinal principles "Economy of force" and "Unity of control." It supplies no systematization of control of training or practice, except through non-technically-expert sources.

Master General of Ordnance (in addition to his other duties)

Director of Artillery (in addition to his other duties)

Liaison with D.G.A.M.S.

A.M.D. 6
Represented on Main and Sub-Committees, C.W.C.[1]

Commandant, Experimental Station, Porton.

C.W. School under selected Regimental Officer.
Proposed that R.A.M.C. Officers and possibly N.C.O.'s should attend sometime; none so far.

Physiological Dept., which includes 3 R.A.M.C. Officers and 6 other ranks, on a 3-year appointment.

[1] C.W.C. = Chemical Warfare Committee. This is a body which, at present, controls the whole of Chemical Warfare Policy and Research. It is composed of eminent scientists of various branches of science, with ex officio members from each of the three fighting services. The M.G.O. is the Army member. Under it are a multitude of sub-committees, amongst which are the Physiological and Medical.

Up to date the scheme has produced no systematic training or practice whatever for the formation which should be primarily concerned with the problems of defence, the Royal Army Medical Corps; for the officers and non-commissioned officers in the Physiological Department at Porton are research workers on the scientific staff of the station.

The Future.

Before passing on to put forward the details of the suggested schema for the pure defence side of a special Chemical Warfare Service let us recapitulate the basal contentions on which it is founded, and which are set out at some length in Parts I and II of this series:—

(1) Control and co-ordination of the varying factors which go to make up the whole, by those who are really responsible and are in a position to bring a complete understanding of the problems involved.

(2) The removal of the anomalies which result from the vesting of *de jure* and *de facto* responsibility in different hands, thus depriving the experts—who naturally carry the *de facto* responsibility—of executive power and giving it to the non-experts with *de jure* responsibility.

(3) Conservation of energy by unity of control.

In other words the formation of an Executive Health (Medical) Service to deal entirely and completely with all matters which are included in the vital and hydra-headed problem of the provision of healthy men. It hardly needs emphasizing that the prevention of disease and the treatment of sick or wounded are necessarily included in the provision of healthy men, and it is self evident that C.W. defence comes into the same category as prevention of disease.

Director of Chemical Warfare.
Probably M.G.O. in addition to his other duties.

Dep. Dir. C.W. "A."
Probably one of the D.'s of "A" in addition to his other duties, at any rate at the beginning. Ex officio member of C.W. Main Committee.

Dep. Dir. C.W. "H"
Suggested Dir. of Hygiene in addition to his other duties *if the corresponding "A" is the same,* if not then a special whole-time appt. Ex officio member of C.W. Main Committee. 4-year appointment.

Commandant Exp. Station, Porton.

C.W. School, Porton.

"A" branch i/c specially selected Reg. Officer

"H" branch i/c selected Health Corps (seconded) Officer. 3-year appointment

Whichever is senior will be O.C. School.

Three Health Corps (seconded) officers of the Physiol. Dept. of not less than 8, or more than 12 years' service. 3-year appointment.

A.D.C.W. "H" Staff Officer to D.D.C.W. "H," ex officio member of Phys. and Med. Sub-committees. 3-year appointment

Three Specialist C.W. "H" Branch Officers, graded as D.A.D.C.W. "H," one for Northern and Scottish, one for Western and Irish, one for Southern, Eastern, and London District Commands

Regimental Officers, trained at the C.W. School, Porton, and with their Depot or Unit (now with Units only and known as "Anti-gas Officer" or "Gas" Officer)

A.D.C.W. (Training) "H" temporary appointment. *See* notes on schema.

Notes on Duties.

D.D.C.W. "H."—General supervision, co-ordination, and control of all purely defensive C.W. organization and training, subject only to the approval of the Director of C.W. Direct responsibility for policy and practice.

A.D.C.W. "H."—(1) Close liaison with physiological and medical sub-committees, with other fighting services, voluntary aid and civilian organizations in general, the Experimental Station, Porton, generally, and specially with the C.W. School and the Physiological Department through Commandant, Porton.

(2) Control and co-ordination of: (*a*) Schemes for mechanical defence, such as proofing of ambulances, tanks, dug-outs, etc. (*b*) Schemes for the protection of personnel, either individual or communal or both, including the care of the respirator, protective clothing and factory workers. (*c*) Schemes for deturging (de-gassing) food, materials, clothing, equipment, etc. (*d*)

Defensive training, and the elaboration and practical adoption of the above schemes. (*e*) Modification of existing practices to meet new substances or the development of old ones. (*f*) All questions relating to casualties, their collection, evacuation and treatment, including the provision of special equipment for units and the provision of standard equipment for C.W. "Teams" (analogous to the equipment for Surgical Teams). (*g*) Intelligence: summaries and docketing for reference of matter concerning the defensive work of armies, the preparation of manuals, and of pamphlets for issue on mobilization if required, etc.

A.D.C.W. "H" (Training).—Specially selected officer to supervise all defence training of the Army, and to lecture to Officers and N.C.O.'s of all branches of the Regular and Territorial Army, including Staff, Staff College, Units and Services. Graded as A.D.C.W. "H" with headquarters at the War Office but to be almost his whole time on tour. This appointment would only be required for a short time, say three years at the most, and to be superseded as soon as the general standard of training is satisfactory by the Specialist Officers in Commands, who would be appointed as soon as individuals sufficiently trained for these posts became available, and by general supervision and control under the A.D.C.W. "H."

Specialist Officers.—Supervision of defensive training, both winter and summer, and liaison with A.D.C.W. "H" on all matters controlled by him.

Attached to G. S. branch of Command Staffs, not to the Medical branch unless the latter were executive, i.e., "4th Branch of the Staff, 'H' Branch."

Note.—As will be seen from the following diagram it is postulated that the A.D.C.W. "H" and A.D.C.W. "H" (Training), revert to the Corps on termination of their tour in the appointment. This is subject to the possibility of a post becoming available in keeping with their seniority, such as may well happen by growth of the Service, or in our Overseas forces, or in the Dominions as Instructor and Organizer in the event of their taking up the subject of C.W.

A conception of a possible internal organization of the Officers (see next p.).

Rank, Pay and Allowances.

A.D.C.W. "H."—Lieutenant-Colonel (or to carry temporary rank and pay of Lieutenant-Colonel), with the special staff pay of an A.D.M.S.

D.A.D.C.W. "H."—Lieutenant-Colonel or Major (or to carry temporary rank and pay of Major) with specialist pay at 5s. per diem.

Officer at the C.W. School.—To rank as for D.A.D.C.W. "H."

Officer at the Phys. Dept., Porton.—Pay of substantive rank plus specialist pay at 5s. per diem, specialist pay and tenure of appointment to start after conclusion of Course of Instruction.

N.C.O.'s.—Substantive rank Serjeant and upwards, local rank and pay of Serjeant for all others; the above to be subject to the proviso that all

ranks shall be eligible for such "danger," or other special pay or allowances as shall be granted to other ranks in the C. W. Service.

Diagrammatic Representation of Suggested Internal Organization.

	A.D.C. W. "H."	Specialist C.W. "H" Officer	Officer at C.W. School, Porton	Officer at Phys. Dept., Porton	Other C.W. post	Corps Depot	Revert to Corps
A.D.C.W. "H" ..							X
					X		
A.D.C.W. "H" (Training)	X						
							X
Specialist C. W. "H" Officer	X						
			X				
							X
					X		
Officer at C.W. School, Porton	X						
		X					
				X			
				X			
					X		
Officer at Phys. Dept., Porton	X						
		X					
			X				
							X
					X		
N.C.O. at—							
Phys. Dept., Porton		X					
			X				
						X	
							X
C. W. School, Porton		X					
				X			
						X	
							X
Specialist Officer C.W. "H"			X				
				X			
						X	
							X
Depot of Corps with Training Officer		X					
				X			
			X				
							X

On first appointment from the Corps all Officers and N.C.O.'s to go to the Physiological Department, Porton. The lines above indicate possible subsequent moves to or from the various appointments.

"Other C.W. Post" suggests the probable growth of the Service, and inherent in this conception is the possibility of subsequent permanency of a transfer to it. Also applicable to other ranks.

Appointment to Chemical Warfare Service.

Officers—Power of first appointment to rest with D.D.C.W. "H," subject to approval of D.C.W. and D.G.M.S.

Other ranks.—Ditto, but also six months' probation at the Physiological Department, Porton, before confirmation of appointment and grant of local rank and pay of same, if any.

All Officers and other ranks to be seconded from the Corps but to be required to pass the usual promotion examinations as and when due.

Power of transfer within the service to rest with D.D.C.W. "H."

Power of reversion to the Corps to rest with D.D.C.W. "H," subject to the approval of D.C.W., said reversion to be allowed to any Officer or other rank if desired at the termination of any tour of appointment.

REFERENCES.

[1] "Official History of the War: Medical Services, Diseases of the War," vol. ii, p. 328 *et seq.*
[2] Fuller. "The Reformation of War."
[3] Gilchrist, H. L. "The Medical Officer and Chemical Warfare," *The Military Surgeon*, August, 1924.

OBSERVATIONS ON THE GROWTH OF MENINGOCOCCI *IN VITRO* IN RELATION TO VIRULENCE.[1]

A Report to the Medical Research Council on Work carried out at the University of Cambridge Pathological Laboratory and Field Laboratories.

By E. G. D. MURRAY and R. AYRTON.

(*Continued from page* 369.)

(*i*) *The Influence of Agar-agar.*

Certain influences of agar have been discussed (Section II), but there are a few other points worth considering. Agar in "powder" or other "specially prepared" form is less satisfactory than plain "bleached fibre" (China grass); principally because the prepared agar is much less constant in the character of the jelly furnished by different batches.

Although treatment with acid probably increases the imbibition of the agar, we have not observed any particular advantage exhibited by agar so treated.

There is, however, one disadvantage in washed agar used wet, that it absorbs and holds about eight times its dry weight of water in spite of squeezing it as hard as it will allow; when the concentration of dry agar used in the medium is 2 per cent, this water dilutes the extract used by 16 per cent, and in order to avoid this in experimental media we used to dry the agar after treating it with acid (0·01 per cent H_2SO_4) and washing until acid free, on the lines indicated by Cunningham (1919). We have, however, abandoned this process in favour of four washings with distilled water, wringing the agar as dry as possible in a clean cloth between each.

Up to the present we have not investigated the influence of agar on the growth of the meningococcus, although we have noted some observations which tend to show that it is not the inert substance it is usually supposed to be.

The concentration of agar we favour in our medium at present is two per cent of dry fibre, principally because this gives a sufficiently firm jelly, enabling us to scrape the growth off its surface without risk of taking up pieces of agar which would falsify our weighings. Nevertheless a more ready growth is obtained on lower concentrations, and the work of Jenkins (1921) on the gonococcus is instructive; although we are not inclined to confine the activity of agar to concern moisture only.

In our opinion the influence of agar is one of the difficult factors to control in making media and concerning which very little is known.

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[1] Reprinted from the *Journal of Hygiene*, vol. xxiii, No. 1, October 15, 1924, by kind permission.

(*j*) *Summary of the Method of Making "EHD Agar.*

(1) *The Extract.*—Ox heart muscle, which has been killed not more than twenty-four hours, is freed of fat, minced, but not too finely, and suspended in twice its weight of distilled water in an open can in a steamer and its temperature raised gradually to 70°—75° C., with occasional stirring to prevent the surface layer getting too hot. This temperature is controlled by a thermometer in the mixture. After three hours the temperature is allowed to rise to 100° C. for fifteen minutes to get a firm coagulum. It is then filtered through its own meat, as described under (*a*) of this section. *Do not filter through lint or paper.* This furnishes the extract, which can either be autoclaved and stored, or used immediately to make a four per cent solution of agar.

(2) *The "EH Agar."*—Proceed as in making the extract until the end of the three hours' heating at 70° to 75° C., then filter through the meat. To this filtrate is added an equal volume of the four per cent solution of agar in extract after cooling it to 70° C.; this mixture is returned to the steamer and raised to 100° C. for one hour. It is then *left to set* and stand overnight. The next morning it is melted and strained through lint. This filtrate is the "*EH* agar," which can be autoclaved and stored if not required immediately.

(3) *The Finished "EHD Agar."*—To the required amount of melted "*EH* agar" are added: 0·25 per cent NaCl, 0·02 per cent KCl, 0·01 per cent $CaCl_2$ and the desired concentration of digest (Section V). The reaction is adjusted to *p*H 7·2 and the medium distributed as required and autoclaved at 120° C. for twenty minutes.

(4) *The Digest.*—The residual meat and fine coagulum filtered off from the extracts are suspended in a quantity of *N*/100 HCl equal to the weight of original raw meat. This bulk is raised to 100° C. and then autoclaved at 133° C. (25 lb. to the square inch) for thirty minutes, then cooled to 37° C., incubated twenty-four hours and its sterility assured. Then two per cent of sterile pancreate extract is added and left in contact with the HCl for five to fifteen hours to activate the trypsin, after which 0·8 per cent anhydrous Na_2CO_3 is added in the form of a sterile thirty-two per cent solution. This strength of Na_2CO_3 readily dissolves at 37° C. Digestion is allowed to proceed until a "Sörensen figure" of not less than twenty is produced (see (*b*) of this section). When this result has been obtained, two per cent of N/10 HCl is added and the digest autoclaved and while still hot filtered through paper in a hot funnel. The acidified digest filters quite as rapidly as it is slow when alkaline. At least one advantage of strict sterile precautions is that the digest retains a pleasant meat-like smell throughout the process, both in the alkaline and the acid condition. Any objectionable smell or traces of H_2S detected shows that contamination has occurred. The filtrate is put into clip-top milk bottles and autoclaved at 120° C. for twenty minutes, and repeated autoclaving has no apparent deleterious effect.

V. The Influence of the Constitution of the Medium on Virulence.

Attention has already been drawn to our observation that the killing power of a given strain of meningococcus was greater or less according to the medium on which it was grown (Section IV (*b*)) and that we were then inclined to attribute the alteration in the physiological state of the parasite, resulting in a lowered virulence, to the contamination of our digest by certain other organisms during digestion. We have not been able to demonstrate that such contamination has this definite effect.

Nevertheless this primary observation induced us to investigate the relation of growth to medium, not so much from the point of view of the mass yielded by the medium as the physiological state of the growth, measured by its capacity to kill mice inoculated intraperitoneally.

This line of research has yielded what we venture to think are important results and we propose to consider them in some detail.

The killing power of a culture is estimated by determining the minimal lethal dose in the way described by Murray (1924, p. 177), and, in our attempt to determine what constitutes a good medium, although we regard variation in killing power as more important, we have not neglected to observe the mass of growth yielded. At the outset we discontinued the use of contaminated digests and confined our attention to those made with strict sterile precautions, with the intention of reverting to our first observation by means of controlled growth, of known organisms, in digests which proved to give good results.

As has been stated, our early sterile digests had a much lower "Sörensen figure" than did the contaminated ones and our first endeavour was to produce sterile digests with a concentration of amino-acids quite as high as that which the contaminated digests appeared to possess. This was particularly desirable as we thought that the general amino-acid concentration, indicated by the "Sörensen figure," might afford a means of standardizing media both from the point of view of virulence and growth.

The following experiment bears directly upon these ideas and the results are very instructive. We prepared three solutions :—

(*a*) In 3,000 c.c. of extract we dissolved 2 per cent of washed and dried agar, 0·5 per cent NaCl, 0·125 per cent $CaCl_2$ and adjusted the reaction to *p*H 7·2. This solution was then filtered through lint which had been washed with boiling distilled water.

(*b*) 250 c.c. of digest No. 109, with a Sörensen figure of 32·0 c.c. N/10 NaOH on 10 c.c. of digest, was treated like the extract in (*a*).

(*c*) 650 c.c. of digest No. 118, with a Sörensen figure of 13·1 c.c. N/10 NaOH on 10 c.c. of digest, was also treated like the extract in (*a*).

These three solutions were then mixed in the proportions shown in Table VI to make media *A*, *B* and *C*. The reaction was checked with the interesting result that it needed readjusting in each of the *B* and *C* media.

These were then distributed in 100 c.c. volumes in marked flasks and autoclaved at 120° C. for twenty minutes. When the media were used they were melted and cooled to 50° C. and five per cent of ascites fluid was added, three plates of each were poured, all of which were inoculated consecutively from a growth of a fairly virulent strain, first generation from an egg culture on a medium known to give good results. A sixteen hours' growth on the various media was inoculated intraperitoneally into mice (= second generation from the egg culture = first generation on the special media), two mice were used for each dose. The results of this experiment are shown in Table VI.

In considering these results it must be observed: Firstly, that the accessory growth factors were supplied by ascites fluid and for that reason growth was obtained on medium *A*; also that the ascites fluid used was then beginning to influence the sticky character of the growth (Section IV (*h*)). Secondly, that the concentration of NaCl added may be considered to be high (Section IV (*d*)), and that we did not take into account the salt content of the digests. Bearing these points in mind, the physical character of the growth is capable of interpretation. With regard to the mass of growth yielded by the various media, it is evident that the addition of digest not only increases the yield compared with medium *A*, but that there is some suggestion of an optimal range of concentration, which is more marked in the *C* media than the *B*. Further, the difference between the *B* and *C* groups of media bears no marked relation to the "Sörensen figure" increment due to the digest. At the same time there appears to be a definite decrease in the percentage of moisture in the growth yielded by the high concentrations of digest compared with the low, but this may be due to the contained salts (see Table V).

The outstanding feature of the experiment is the behaviour of the cultures towards mice. This shows definitely that there is an optimal range of concentration of digest, which alone affords the meningococcus such conditions that allow of its development of something essential to its manifestation of a parasitic existence. Furthermore, this "virulence range" appears to be independent of the increment of the "Sörensen figure" due to the digest, and, except in the case of the *C* media, it does not show any marked relationship to the mass of growth yielded. On the grounds of deficiency, it is not surprising that the effective range of the digest should exhibit a low limit, but it could not have been expected that an upper limit would be found; this suggests the presence of an inhibition factor overpowering the effect of the presence of a sufficiency of the necessary substances. Yet this upper limit is definitely marked in both the *B* and *C* media.

In each of eight experiments performed, using different digests, we obtained results strictly like those detailed above. Experiments of this nature present many difficulties when working with the meningococcus, besides involving the use of a considerable number of mice, and it is not always possible to insure that all the factors contributing to success will

be in working order at the desired moment. In our experience the "virulence range" of a digest is difficult to determine if the strain used for the test is of a very high order of virulence, as the range may then appear to be unnaturally extended. In practice we prefer to employ and get best results with a strain two milligrammes of which kills twenty grammes of mouse within fourteen to forty-eight hours, when grown on the medium of optimal concentration of digest. A strain exhibiting a minimal lethal dose of four milligrammes is often useful, but one with a minimal lethal dose of one milligramme kills when grown on media which are not the best. We believe that the medium giving best results with an organism of failing virulence probably is also the best for the very virulent.

TABLE VI.

Medium No.	°/₀ concentration in (a) of (b)	(c)	Increment of Sörensen figure in c.c. *N*/10 NaOH on 10 c.c. due to added digest	Generation	Growth in mgm. per sq. cm. of 5 successive generations on each medium: Moist	Dry	Dry growth as a °/₀ of moist	Character of growth	Killing power of the first generation on each medium (2 mice to each dose): Dose in mgm. of living culture per 20 grm. mouse	Result
A	0	0	0	1	1·02	0·18	17·5	All slightly sticky	8	Both lived
				2	0·80	0·13	16·7			
				3	0·54	0·09	16·7		4	,,
				4	0·60	0·10	17·2			
				5	0·95	0·17	18·2		2	,,
B 1	2	0	0·64	1	1·35	0·25	18·2	All slightly sticky	8	Both died
				2	1·23	0·20	16·2			
				3	1·23	0·21	17·3		4	,,
				4	1·16	0·20	17·7			
				5	1·28	0·26	20·0		2	One died
B 2	8	0	2·56	1	1·32	0·25	18·7	Sticky	8	Both died
				2	1·61	0·31	18·9			
				3	1·50	0·28	18 6		4	,,
				4	1·53	0·28	18·8			
				5	1·46	0·30	20·5		2	One died
B 3	32	0	10·24	1	1·43	0·29	20·3	Very sticky (2nd gen. too sticky to scrape properly)	8	Both died
				2	(0·9)	(0·15)	16·9			
				3	1·37	0·25	18·2		4	One died
				4	1·00	0·20	20·2			
				5	1·55	0·31	20·0		2	Both lived
C 1	0	5	0·65	1	0·99	0·20	20·1	Sticky	8	Both died
				2	0·81	0·13	16·4			
				3	1·36	0·26	19·2		4	Both lived
				4	1·28	0·24	18·6			
				5	1·71	0·32	18·4		2	,,
C 2	0	20	2·60	1	1·58	0·31	19·8	Very sticky (5th gen. too sticky to scrape properly)	8	Both died
				2	1·55	0·33	21·1			
				3	1·13	0·23	19·9		4	,,
				4	1·35	0·30	22·2			
				5	(0·8)	(0·15)	19·2		2	,,
C 3	0	80	10·40	1	—	—	—	Sticky	8	One died
				2	1·10	0·25	22·7			
				3	0·74	0·19	25·5		4	Both lived
				4	0·87	0·22	25·0			
				5	0·70	0·19	26·6		2	,,

The highest "Sörensen figure" we have met with in our sterile digests was one of 49; the lowest observed effective concentration of this digest, as determined by virulence, was 1·8 per cent, a concentration of 0·54 per cent gave a good yield of growth but of markedly reduced virulence; the highest effective concentration observed was 15 per cent, but higher concentrations were not tried for virulence, but 21 per cent gave a reduced yield of growth.

The digests exhibiting a "Sörensen figure" of not less than 20 had a wider effective "virulence range," particularly noticeable in that it extended to much lower concentrations of digest in the medium than those other digests whose "Sörensen figure" was in the region of 12 to 15. It is for this reason that we consider digestion sufficiently advanced for our purpose, only when the "Sörensen figure" has a value of not less than 20 (See Section IV (*c*)).

One other experiment may be quoted in detail, as it illustrates our general experience of the relation of growth to virulence in the type of experiments now under consideration. In this case the basis of the medium was "*EB* agar" (Section IV (*h*)) and the salt concentrations were 0·25 per cent NaCl, 0·01 per cent $CaCl_2$ and 0·02 per cent KCl (Section IV (*d*)). The concentrations of digest and general results are shown in Table VII.

TABLE VII.

Medium	°/₀ concentration of digest 150	Increment to Sörensen figure due to the digest in c.c. $N/10$ NaOH to 10 c.c. of medium	Arithmetical mean of: Moist growth in mgm. per sq. cm.	Dried growth in mgm. per sq. cm.	Dried growth as a °/₀ of moist growth	M.L.D. in mgm. per 20 gm. of mouse (1st gen. on medium)
A	1	0·24	2·8	0·49	18·6	8
B	2	0·48	3·2	0·57	17·8	2
C	4	0·96	3·2	0·58	18·5	2
D	8	1·92	3·0	0·55	18·1	4 (± 2)
E	16	3·84	2 plates were contaminated, 1 used for mice. Further generations not continued			8

It is evident that, although a marked difference in killing power exists between the growths obtained on the various media, the differences in the yield of growth per unit area of medium are relatively slight and certainly would not be appreciated by inspection. For reasons such as the result of this experiment, we do not believe that the yield of growth is necessarily a reliable index of a good medium for highly specialized parasitic bacteria. The variation in the percentage of moisture, which is the chief source of error in carefully measured doses of weighed growth, cannot be held accountable for the differences in killing power of the cultures.

As the result of this inquiry, we were naturally forced to the conclusion that the standardization of a medium for the meningococcus is a much more difficult and delicate matter than our previous experience and the literature of the subject had led us to believe.

By taking into consideration the "virulence range" of the digest and by adjusting the various other factors discussed in Section IV, we evolved our

"*EDB/V*" and "*EHD/V*" medium (V = virulence). The yield of growth and degree of constancy of this medium have been discussed in Section III (Table I), where it is shown to be the best medium we know at present.

Although we have shown quite definitely that this "virulence range" exists, we have no idea of its underlying cause; and we have not succeeded in devising a sufficiently delicate test whereby to determine the optimal point in the range. Our present practice, in making the medium, is to use an amount of digest a little higher than the lowest effective concentration determined by the killing power of the cultures on mice. This requires that each digest has to be titrated by experiments using the minimal lethal dose of a suitable culture as the indicator, and although it may be considered a troublesome necessity, we are convinced that it is well worth while. In order to minimize the labour we make amounts of digest varying between two and six litres, and, since the required concentration is only in the region of two per cent of digest, these large volumes make a considerable quantity of effective medium.

We may now reconsider the question raised concerning the effect of contamination of the digest in the course of its manufacture. We took a sterile digest, the "virulence range" of which we had determined, neutralized and contaminated a portion of it with *Bacillus subtilis*. That organism would only grow with great difficulty in the concentrated digest, although abundant, typical growth was obtained in dilutions. In time, however, sufficient growth had taken place for a deposit of fluffy balls of bacilli to accumulate at the bottom of the vessel, but no surface film was formed, though abundant typical growth resulted with subculture on to ordinary media. This purposely contaminated digest was then filtered through a sterile Pasteur-Chamberland candle "*F*" and the filtrate was used in varying concentrations to make media. So far as we could discover, the "virulence range" had not been altered by the contamination. The experiment was repeated with the same result. But two things must not be lost sight of: firstly, the degree of contamination was comparatively slight for a freely growing organism like *B. subtilis*; and, secondly, our original digests were contaminated by a varying mixture of organisms, including anaerobes.

Before proceeding further with this type of experiment we thought fit to examine some of the old "non-sterile" digests we had kept. Varying amounts of seven different digests, which had been used for making "*EDB/N*" medium, were pooled; in a portion of this we dissolved two per cent of dry agar and this solution was mixed with *EH* agar in the proportions shown in Table VIII. In adding the salts allowance was made for the NaCl content of the digest, and the final concentrations were 0·25 per cent NaCl, 0·01 per cent $CaCl_2$ and 0·02 per cent KCl. The media were inoculated with a strain of good killing power, from a culture first generation from egg (M.L.D. = 2·0 milligrammes of growths on *EHD/V* for 20 grammes of mouse).

From the result of this experiment (shown in Table VIII) it is quite

evident that the pooled digest has a "virulence range," in spite of having been contaminated during digestion. But we now regret that we did not examine each of the digests separately, for it is probable that they had individual differences.

TABLE VIII.

Medium	% concentration of pooled "non-sterile" digest	Increment of Sörensen figure due to digest	Growth in mgm. per sq. cm.		Dried growth as a % of moist	M.L.D. in mgm. per 20 gm. of mouse (= 1st gen. on these media = 2nd gen. from stock egg)
			Moist	Dried		
A	0·5	0·18	2·2	0·32	14·8	4
B	2	0·71	2·5	0·38	15·4	2
C	8	2·85	3·0	0·49	16·6	2
D	32	11·39	2·1	0·40	19·2	4

Our original conception that contamination altered the digest, to an extent which interfered with the virulence of the cultures grown on it, is shown by the above experiment to be without foundation.

The difference we originally observed between certain "contaminated" and "sterile" digests, in regard to the virulence of the growths they respectively yielded, is readily explained by the fact that the media were then made by adding the amount of digest required to give a definite increment in the Sörensen figure. This method we have since shown to be unreliable, as the Sörensen figure bears no relation to the "virulence range" of the digest; this is amply demonstrated in Tables VI, VII and VIII. Even though contamination of the material during the course of digestion does not decrease its value, we strongly advise the adoption of strict precautions, if only to avoid the very objectionable smell which often results from contamination. Sterile digests have, in fact, a very pleasant and appetizing smell.

(*To be continued.*)

A COMMAND STAFF EXERCISE.

By Major W. EGAN, D.S.O.
Royal Army Medical Corps.

(*Continued from p.* 363.)

Supplies for Consumption, June 11.

1st Division with units.

2nd Division in train lorries en route from S.R.P. to troops (owing to darkness, bad roads and upset lorries).

Corps Troops with units.

1st D.A.C. (Full). Parkend.

2nd D.A.C. (Full). Pitcox Smithy.

1st Division M.T. Company
2nd Division M.T. Company } Ammunition Section
M.A., H.T. Company } Cockburnspath.

1st Reserve M.T. Company 1 Advanced M.T. Vehicle Reception Depot parked on Dunbar—Cockburnspath Road.

No. 1 Auxiliary H.T. Company
Headquarters 2nd Division Train } Doon.

Baggage Section of No. 1 Company, 2nd Division Train. Head at Belton House.

No. 1 Casualty Clearing Station. Open at Grantshouse.

No. 2 Casualty Clearing Station. In process of erection at Cockburnspath.

1st M.A.C. Grantshouse empty, having evacuated wounded to C.C.S

7th Field Ambulance. Grantshouse.

No. 1 V.E.S. Innerwick.

Note.—With reference to the whole Front units, Administrative and otherwise not mentioned above may be located as convenient.

D.D.M.S.
D.T.
From 1st Corps "A."
A.5. 11.6.24.

D.D.M.S. will move No. 1 Casualty Clearing Station to Dunbar by rail. D.T. will arrange transport, No. 1 M.A.C., 7 Field Ambulance, 3 Sanitary Section to Dunbar by road. AAA D.T. will arrange for an Ambulance Train to be sent to Dunbar AAA Moves take place forthwith.

Addressed to D.D.M.S., D.T.

Copy to "G." Time of origin 12.30 hours.

Commanding 1st Casualty Clearing Station.
From Medical 1st Corps.
M.5. June 11.
Close and prepare to move by rail to Dunbar and open there AAA D.T. arranging transport AAA Ambulance train will evacuate from Dunbar to-day AAA Advanced Depot Medical Stores moves to Dunbar with you. Time of origin 11.30 hours.

Commanding 1st M.A.C.
From Medical 1st Corps.
M.6. 11.6.24.
Move to Dunbar forthwith AAA Report arrival and location AAA M.T. of 7th Field Ambulance will move with you.
Time of origin 11.35 hours.

Commanding 3rd Sanitary Section.
From Medical 1st Corps.
M.7. 11.6.24.
Proceed to Dunbar forthwith. Time of origin 11.36 hours.

Commanding 7th Field Ambulance.
From Medical 1st Corps.
M.8. 11.6.24.
Proceed by road forthwith to Dunbar AAA Your M.T. to move with M.A.C. Time of origin 11.37 hours.

Medical 1st Division.
Medical 2nd Division.
Medical Cavalry Brigade.
From Medical 1st Corps.
M.9. 11.6.24.
Report present location main dressing stations, number of casualties and transport classifications AAA M.A.C. cars will evacuate to No. 1 Casualty Clearing Station at Dunbar AAA Advanced Depot Medical Stores Dunbar. Time of origin 12.00 hours.

Commanding No. 2 Casualty Clearing Station.
From Medical 1st Corps.
M.10. 11.6.24.
Close and park ready to entrain on receipt of orders.
Time of origin 14.15 hours.

Commanding 1st M.A.C.
From Medical 1st Corps.
M.11. 11.6.24.

Cavalry casualties eight lying, twenty-two sitting, at M.D.S. Dunskine AAA Evacuate to Dunbar by Whittinghame—Garvald road AAA 1st Divisional Main Dressing Station at Beltonford, 2nd Division at Easter Broomhouse AAA At each approximately 180 casualties AAA Arrange evacuation to No. 1 Casualty Clearing Station at Dunbar.

Time of origin 14.40 hours.

Remarks by the Directing Staff on M.5.

No. 1 Casualty Clearing Station only moved to Grantshouse yesterday and had to take in 500 casualties before it was ready for their reception.

It now moves to Dunbar—when in the midst of opening up—

It is considered that owing to rapid moves this Casualty Clearing Station is useless as a Medical Unit to the force.

(Signed) DIRECTING STAFF (Medical).

SECRET.
Copy No.—

1st CORPS ORDER No. 9.

June 11, 1924.

Reference Map O.S. of Scotland, Sheets 32 *and* 33, *one inch to one mile.*

(1) The enemy is in full retreat on Edinburgh. His rear guard is occupying the ridge south south-west of Tranent.

(2) The advance guard will be continued on the 12th to the line Musselburgh—Dalkeith.

(3) (*a*) 1st Cavalry Brigade with 1st Armoured Car Company and one company 2nd Tank Battalion attached will move from Pencaitland at 0.600 hours, 12th inst., on Parth Head. Their first objective will be to make good the high ground between Parth Head and Dalkeith. Thence they will be directed on Lasswade.

(*b*) 1st and 2nd Divisions will march in accordance with attached March Table. Dividing line between Divisions will be River Tyne to Haddington. Haddington—Pencaitland Road (inclusive to 2nd Division) as far as Cross Roads, one mile north-east of Easter Pencaitland. Thence a line to Winton Station (exclusive of 2nd Division). Railway to Crossgate Hall (inclusive to 1st Division). Northern boundary of Dalkeith Park.

4) The following preparatory moves will take place :—

(*a*) 1st Lancers to detail one squadron to come under the orders of the G.O.C. 2nd Division from 22.00 hours, 11th, at which time the 1st Lancers (less one squadron) will come under the orders of the G.O.C. 1st Division.

(b) 1st Armoured Car Company to move at 22.00 hours from Drem via Haddington to Cuddie Wood, where they will come under the orders of the O.C. 1st Cavalry Brigade.

(c) 1st Tank Battalion will assemble at Newbythe, where it will come into Corps Reserve, all movement to be confined to the hours between 12 midnight, 11th, and 02.00 hours 12th.

2nd Tank Battalion (less one company) will move at 22.00 hours from Beltonford via Dielgrange—Standingstone—Cocklins—Lennoxlove. On arrival at Lennoxlove one company will come under the orders of 2nd Division and one Company under the orders of the O.C. Cavalry Brigade.

One Company 2nd Tank Battalion will move from Beltonford at 03.00 hours on the 12th via East Linton—Athelstane Road to Kilduffs Wood, where they will come under the orders of the 1st Division.

(d) The Air Defence Commander will detail one battery of A.A. Artillery to each of the 1st and 2nd Divisions.

(5) One Brigade, 1st Division, will be detailed as Corps Reserve and march at the rear of the 1st Division.

(6) Corps R.E. will be responsible for the upkeep of the following roads for Motor Transport:—

East Linton—Haddington—Tranent—Grangemuir—Standingstone—Parkend—Samuelstone—Pencaitland.

(7) *Inter-communication.*

(a) Reports to Anisfield House after 06.00 hours, 12th.

(b) Central Visual Stations will be established at Traprainlaw, call ACOA and Garleton Hill, call ACOB. Messages to the latter will be sent on F. procedure (i.e., the central station will not answer) at 05.30 hours.

(c) Telegraph lines west of Haddington to be cut every three miles as troops advance.

(d) Wireless call—sign—wave-lengths and final letters remain unchanged from those given in Corps Order No. 8 of 10.6.24. Appendix "A."

(e) Dropping station and landing ground will be established at Anisfield Park.

Issued to Signals.
13.30 hours.

* * * *
Colonel,
General Staff, 1st Corps.

Copy No. 1.	1st Division.	Copy No. 16.	C.E.
2.	2nd Division.	17.	C.S.O.
3.	1st Cavalry Brigade.	18.	D.A.D. Survey.
4.	1st Lancers.	19.	A.D. of T.
5.	1st Corps Arty. Commdr.	20.	A.D. of S. and T.
6.	1st A.A. Arty. Brigade.	21.	D.D.M.S.
7.	C.R.E., Corps R.E.	22.	A.D.V.S.
8.	1st Tank Bde.	23.	D.A.D. Postal.
9.	1st Armoured Car Coy.	24.	A.P.M.
10.	G.O.C.	25.	Camp Commandant.
11 & 12.	"G."	26 & 27.	War Diary.
13 & 14.	"A" and "Q."	28 & 29.	File.
15.	Intelligence.	30.	Hd.Qrs.1st wing,R.A.F.

SECRET.
Copy No.—

EXTRACT FROM ADMINISTRATIVE INSTRUCTIONS TO ACCOMPANY CORPS ORDER No. 9.

(8) *Medical.*—The following medical arrangements will be in force from 06.00 hours June 12.

(*a*) No. 1 Casualty Clearing Station at Dunbar, open.

(*b*) No. 1 Advanced Depot Medical Stores at Dunbar, open.

(*c*) No. 2 Casualty Clearing Station at Cockburnspath, closed and parked ready to entrain.

* * * *

Colonel,
D.A.A. and Q.M.G.
1st Corps.

Copies to all recipients of
Southland Corps Order No. (9).

SECRET.
Copy No.—

1st CORPS R.A.M.C. ORDER No. 3.

June 11, 1924.

Issued Reference 1*st Corps Order No.* 9.

Reference Map O.S. of Scotland, Sheets 32 *and* 33, *one inch to one mile.*

(1) The enemy is in full retreat on Edinburgh.

(2) The advance will be continued on the 12th to the line Musselburgh—Dalkeith.

(3) Divisional and Cavalry Field Medical Units will march and be employed tactically under orders issued from the Headquarters of their formations.

(4) The opening, location and closing of Dressing Stations must be reported to D.D.M.S., 1st Corps.

(5) 1st M.A.C. ... 3rd Sanitary Section, 7th Field Ambulance } March to Haddington. Starting point Dunbar, time 14.00 hours. Route, East Linton.

(6) No. 1 Casualty Clearing Station is open at Dunbar.

No. 1 Advanced Depot Medical Stores is open at Dunbar.

No. 2 Casualty Clearing Station is closed and parked ready for forward movement by train.

(7) Road evacuation of casualties from Main Dressing Station will be carried out by Haddington—East Linton Road to Dunbar (medical railhead).

(8) Reports to Anisfield House after 06.00 hours, 12th.

(9) Acknowledge.

* * * *

Colonel,
D.D.M.S., 1st Corps.

Issued to Signals hours.

Copy No. 1. A.D.M.S., 1st Division.
2. A.D.M.S., 2nd Division.
3. S.M.O., Cavalry Brigade.
4. O.C., 1st M.A.C.
5. O.C., 7th Field Ambulance.
6. O.C., 3rd Sanitary Section.
7. O.C., 1st Casualty Clearing Station.
8. O.C., 2nd Casualty Clearing Station,
etc., etc., for information.

REMARKS BY THE DIRECTING STAFF ON R.A.M.C. ORDER NO. 3.

Para. 6. No. 1. Casualty Clearing Station is presumed to be capable of opening at Dunbar at 06.00 hours on June 12.

This is an impossibility.

As No. 2 Casualty Clearing Station is closed and parked, it follows that no casualty clearing station is available for the reception of casualties on June 12.

(*Signed*) DIRECTING STAFF (Medical).

2ND DIVISION ORDER No. 10.

SECRET.
Copy No.—
June 11, 1924.

Reference Map O.S. of Scotland, Sheets 32 *and* 33, *one inch to one mile.*

(1) The enemy is in full retreat on Edinburgh, his rearguard is occupying the ridge south-south-west of Tranent.

1st Cavalry Brigade with 1st Armoured Car Company and one Company 2nd Tank Battalion move from Pencaitland at 06.00 hours on 12th on Parth Head and Dalkeith, thence advance on Lasswade.

The 1st Corps is advancing on the 12th, 1st Division on right on Musselburgh and Inveresk, 2nd Division on left.

Dividing line between Divisions, River Tyne to Haddington —

Haddington—Pencaitland road inclusive to 2nd Division as far as cross roads one mile of Easter Pencaitland, thence a line to Winton Station (exclusive to 2nd Division). Railway to Crossgate (inclusive to 1st Division). Northern boundary of Dalkeith Park.

(2) The 2nd Division and attached troops "A" Squadron, 1st Lancers, "B" Company, 2nd Tank Battalion, will advance on Dalkeith.

(3) The Division will advance on a two Brigade front, 5th Infantry Brigade on right, 6th Infantry Brigade on left. Dividing line between Brigades, River Tyne to its junction with Dru Birns Water—Ormiston Hall—Byres Loan—Coldhame—Dalkeith Station; 4th Infantry Brigade will follow in rear 6th Infantry Brigade. "B" Company, 2nd Tank Battalion, in rear of 5th Infantry Brigade. March Table attached.

(4) (i) "A" Squadron, 1st Lancers (less one troop) will report by 06.30 hours whether bridges over Tyne Water on both brigade roads are intact.

(ii) Report by 08.00 hours whether high ground west of Tyne Water on front Stone Mine D'Arcy is clear of enemy.

(iii) By 10.00 hours whether country west of railway from Sheriffhall Mains to Dalhousie Mains is clear.
By 13.00 hours whether the line Gilmerton Loan Head is clear.

(iv) *Inter-communication.*—Divisional Headquarters will close at Monkrigg at 08.00 hours, and open at Wolstar, one mile west of Pencaitland, at the same hour.

Reports to head of main body 5th Infantry Brigade.

Dropping station for aircraft messages will be maintained at Monkrigg to 08.00 hours and Wolstar after 08.00 hours.

* * * *

Major,
General Staff, 2nd Division.

Issued by Signals, 16.00 hours.

Copy No. 1.	C.R.A.	Copy No. 11.	G.O.C.
2.	C.R.E.	12.	"Q."
3.	4th Infantry Brigade.	13 & 14.	Office.
4.	5th Infantry Brigade.	15.	War Diary.
5.	6th Infantry Brigade.	16.	1st Corps.
6.	Signals.	17.	1st Division.
7.	A.D.M.S.	18.	1st Cavalry Brigade.
8.	Train.	19.	2nd Squadron (Army Co-operation).
9.	D.A.P.M.	20-25.	Spare.
10.	D.A.D.V.S.		

2ND DIVISION R.A.M.C. ORDER No. 10.

SECRET.
Copy No.—

June 11, 1924.

Reference Map O.S. of Scotland, Sheets 32 *and* 33, *one inch to one mile.*

(1) *Information.*—Enemy is in full retreat on Edinburgh. 2nd Division will advance in two columns converging on Dalkeith.

1st Column, Haddington—Pencaitland—Dalkeith.

2nd Column, Haddington—Humbie Mill—Fala—Pathead—Dalkeith,

(2) No. 5 Field Ambulance will conform to movements of No. 1 Column under orders of 5th Infantry Brigade Commander.

(3) O.C. No. 6 Field Ambulance will detail one Company to follow No. 2 column. As soon as casualties are cleared, H.Q. and remaining company of No. 6 Field Ambulance will follow route of No. 2 column.

(4) M.D.S. at Stenton will be closed as soon as cleared, and 4th Field Ambulance will then move by Stenton—Point 452—Gifford—Leehouses—Point 521, and onwards by route of No. 2 Column. No. 2 Sanitary Section will accompany No. 4 Field Ambulance.

(5) Dressing stations will be opened if, and where, necessary and locations with times of opening and closing notified immediately to A.D.M.S.

(6) Refilling point; supplies for consumption on June 13—Westerbroom House at 20.00 hours on June 12. (2nd Division R.A.M.C. Orders IX, para. 7, cancelled.) Refilling point for 12th, with supplies for consumption on 14th—Road on northern edge of Bolton Moor Wood at 19.00 hours.

(7) No. 1 Casualty Clearing Station is open at Dunbar. Road evacuation of casualties will be carried out by Haddington—East Linton road to Dunbar.

(8) Divisional H.Q. will close at Monkrigg at 08.00 hours and open at Wolstar, one mile west of Pencaitland, at the same hour. Reports to Advanced Division H Q. at head of No. 1 Column.

(9) No. 5 Field Ambulance will bivouac night June 11-12 Amisfield House—Nungate Area.

(10) Motor Ambulance Cars of 5/6th Field Ambulances will advance in bounds at intervals of two hours. Starting point Begbie at 11.40 hours. Those of No. 4 Field Ambulance will report to O.C. 4th Field Ambulance at Stenton.

(11) Acknowledge.

* * * *

Issued at 18.30 hours by D.R.

A.D.M.S., 2nd Division.

Copies to all recipients of 2*nd Division R.A.M.C. Order No.* 9.

A General Conference followed the Exercise and the following were the Remarks by the General Staff on the Medical Aspect of it :—

(1) Some misconception appears to exist as to what information on medical matters should appear in Operation Orders.

The position of advanced and main dressing stations, which are established by Divisional Headquarters on the advice of the A.D.M.S., should be made known to all units in the Division and should therefore appear in Divisional Orders.

Apart from this, as a general rule no other medical information would appear in Divisional Orders.

The A.D.M.S. will, of course, as O.C. R.A.M.C. of the Division, write his R.A.M.C. Orders based on the Divisional Orders, and will issue them to the three Field Ambulances and Sanitary Sections, copies being sent, if necessary, to Infantry Brigades, C.R.A., C.R.E., the General Staff and A.A.Q.M.G., Divisional Train, etc.

(2) *Casualty Clearing Stations.*—(*a*) Casualty Clearing Station accommodates fifty in beds and 150 on stretchers, and takes at least forty-eight hours to be made ready for the reception of casualties.

(*b*) Its Medical personnel consists of 7 Medical Officers, 1 Quartermaster and 76 other ranks, Royal Army Medical Corps.

(*c*) Its transport consists of 3-ton lorries (1st Line).

(*d*) It requires ten lorries to move its equipment.

(*e*) The time in opening is taken up by Royal Engineer works for the provision of water for operating theatres, tent-pitching, railway sidings, roads, etc. It is capable of rapid expansion if suitable buildings or extra tentage is provided. A siding is necessary for the rapid evacuation of a casualty clearing station, as its personnel contains no stretcher-bearers and it has no Motor Ambulance Transport of its own. In open warfare casualty clearing stations are divided into two groups:—

(i) Advanced group seven to nine miles from the front line, and

(ii) The rear group twelve to sixteen miles.

Advances are made by leap-frogging, and as these units are divided into a light and heavy section, the time above quoted, i.e., forty-eight hours, is required for the opening of the light section.

In open fighting the light sections would be trebled in capacity, making the total casualty clearing station accommodation 500 beds per casualty clearing station. With this increase in accommodation twenty-five lorries are necessary.

" It is possible for a casualty clearing station with forty lorry loads to close, pack and repitch and open in a new place in thirty-six to forty-eight hours, which means that they carry as essentials all their canvas, Soyer's stoves for cooking, stretchers, blankets and fifty beds and mattresses, and whatever else the O.C. likes to take to bring up the total to forty loads." (See pages 299 and 300 of the " Official History of the War. Medical Services—General History," vol. iii.)

The above times depend on a party of twenty-five Royal Engineers being available for R.E. work.

ıdical officers taking part in the Exercise,
re made by the Directing Staff on the

ıe appreciations on the whole were good,
ı, except one, ever wrote an appreciation

ever, which demands comment. Appa-
ppreciation did not realize that he was
as such their "expert" on matters of
ent of casualties, with the view of their
ine.
ng-winded, but should be short and to
when necessary. The General Officer
y man, who will only glance through an
e summary and especially that portion
aid down in War Establishments. Con-
n it is well to place your most urgent
st, if it is a long one.
-They were good and, where criticism
a higher Authority had interfered. In
ut on service I want you to realize that
al Service it is your duty to get what
ommander by frequent interviews and

attention :—
has a Headquarters and two companies.
served in South Africa—is a reversion
which existed in that campaign, i.e., a
any. This is not so.
t intend that Field Ambulances should
ent parts except in case of emergency.
units, possess their esprit de corps, and
Field Ambulance personnel get mixed

cal Services, whilst avoiding interference
ances, should, nevertheless, direct their
over a Field Ambulance to its Brigade
happened many times in the 1914 and
arrangements of the Division suffered
or of Medical Services is never absolved
ommanding Royal Army Medical Corps

onal Ambulance Cars—except in a big

battle. In all cases dealing with outpost actions, Field Ambulances should move as a whole and retain their method of evacuation as laid down in War Establishments.

(3) *Senior Medical Officer, Cavalry.*—The instructions issued with the scheme apparently were not comprehensive enough. This officer issued no written orders but made his own arrangements with the Brigade Cavalry Commander. No doubt they were excellent, but how he got rid of his casualties must remain a matter for thought with him for many years to come.

(4) *Deputy Director of Medical Services.*—The casualty clearing stations were moved like pawns on a chess-board, forgetting that it takes some time to move, much less open a casualty clearing station. The following extract is quoted from vol. iii, pp. 299 and 300, "General History—Medical Service":—

"Most of the casualty clearing stations which have moved up to date have moved rapidly and at short notice. At first an attempt was made to move casualty clearing stations with twelve lorry loads. The amount of material, etc., which they could carry on these loads was very limited and quite insufficient to deal with casualties coming in from a big battle. This was stopped and forty lorry loads were allowed. Frequently twenty lorries only were available, and they had to make two journeys in one day; this is quite satisfactory provided the distance moved forward is not too great." (See also remarks at General Conference.)

These casualty clearing stations during this exercise served no useful medical purpose but must have hindered transport arrangements. The casualties arriving at their site would have suffered the greatest hardships. No operations could have been performed and the wounded would very likely have arrived at Berwick-on-Tweed suffering from gas gangrene. I do not see that their field ambulance dressings could have been changed in the majority of cases.

In the hurry of the advance it was forgotten that casualty clearing stations consisted of light and heavy sections, and that advanced operating centres should have been established if necessary with field ambulances. The hygiene and pathological laboratories were also forgotten.

I am indebted to the Royal Army Medical Corps officers taking part in this Exercise for permission to publish their work, and to Colonel R. S. Hannay, C.M.G., D.S.O., D.D.M.S. Scottish Command, for his valuable advice and ready help throughout the Exercise.

Clinical and other Notes.

TREATMENT OF SPRUE BY PARATHYROID EXTRACT.

By Major P. C. FIELD.
Royal Army Medical Corps.

Mrs. R., wife of Lieut. R., a multipara, three children, who had been two years in India, was first seen by me on October 24, 1924.

She was at that time seven and a half months pregnant. During the early part of her pregnancy she had suffered from considerable sickness—this had never entirely ceased and for the past month had become worse; in fact, she could only keep down the lightest descriptions of food in small quantity. For the past six weeks she had also suffered from continual looseness of the bowels, "indigestion pains," and had lost weight to such an extent as to present an appearance of extreme emaciation when first seen by me. Weight six stone twelve pounds. There was a history, on inquiry, of occasional small sore places on the buccal mucous membrane, which came and went. The tongue was markedly sensitive to hot food, mustard, etc., and was lacking in papillæ, furrowed and glistening and smooth in patches between the furrows. The stools were grey and unformed, often frothy and very offensive. In fact the case was fairly typical of sprue.

Treatment.—She was admitted on November 2 and from that date was given parathyroid extract $\frac{1}{10}$ grain morning and evening, and calcium lactate thirty grains daily. In addition, a daily bowel wash of saline was administered. Feeding was difficult, even milk causing discomfort. Diet consisted at first of milk, weak tea, and then toast or Allenbury's malted rusks, and was gradually increased.

Pain after food was a difficulty, but this was greatly lessened by drachm doses of sodæ bicarb. given after meals.

After seven days of treatment, a slight but very definite improvement was established. The stools became a greyish-brown, no longer frothy, and began to be a little formed. The tongue less sore, no aphthæ or soreness in swallowing. Appetite starting to return and spirits improved.

On November 11, slight labour pains started at long intervals at 6 a.m. At 4 p.m. these increased in severity and frequency, and at 6 p.m. a female living child was born weighing four pounds twelve ounces. Difficulty was experienced with the delivery of the placenta, and the chorion was a little torn. The puerperium was complicated by a degree of sapræmia due to a retained piece of membrane subsequently expelled—after that proceeded normally.

On November 30, the general condition was excellent—appetite good and food well tolerated. Motions brown and formed. Bowels regulated by liquid extract of cascara one drachm b.d.

The baby was artificially fed from birth—any attempt at nursing being contra-indicated in interests of mother and child.

December 10.—Patient has gained in weight, is cheerful and looks a different person—is able to take any food of bland and simple nature, walks about the veranda and looks after her baby.

December 13.—Patient discharged from hospital and instructed to continue taking parathyroid.

Total parathyroid taken to date $7\frac{8}{10}$ grains.

The case appears to illustrate in a dramatic manner the successful response to parathyroid medication that sometimes takes place. It may be that the premature labour was in some measure caused by the giving of saline bowel wash-outs. This risk it appeared wiser to take, my reason being that in a former case of sprue under my treatment, in which the bowel wash-outs were prematurely stopped, there was a temporary set-back which disappeared on resumption of the bowel washes. It would appear wiser primarily to treat the sprue and to let the pregnancy look after itself, rather than in any way to modify the sprue treatment. During the frothy motion stage the wash-outs are of undoubted value. There is no doubt of the value of big doses of sodæ bicarb. to relieve stomach pain.

The old treatment of sprue by massive doses of sodæ bicarb. was claimed to give relief.

When seen at the end of January, 1925, Mrs. R. had regained her normal weight, eight stone seven pounds.

She eats ordinary food without any discomfort, manages her house and looks after her baby, unaided. Stools normal and bowels regular.

NOTES ON A CASE OF SPONTANEOUS RUPTURE OF THE SPLEEN IN MALARIA.

By Captain W. CAMPBELL.
Royal Army Medical Corps.

Pte Q., aged 22, was admitted to the British Station Hospital, Allahabad, on September 20, 1924, complaining of severe headache, vomiting, and constipation of four days' duration. His temperatre on admission was 101·2° F., rising to 104° F. in the evening.

On examination he appeared dull and listless; the skin particularly of the face had an icteriod tinge, but the sclerotics were clear. The tongue was coated with dirty yellowish fur. His general condition was poor; he appeared to have lost condition, and, on being questioned, admitted that he had not been feeling well for a fortnight prior to admission. There was no history of malaria, and he had no rigor or even a feeling of "chill" either before or after admission. The spleen was found to be definitely enlarged, extending for two-fingers' breadth below the costal margin, and extremely tender—so tender, that ordinary palpation could not be tolerated,

and even percussion over the left hypochondrium caused pain and tightening of the abdominal muscles. Routine treatment for malaria was prescribed, but quinine by the mouth had to be replaced on two occasions by intramuscular injection on account of vomiting.

His temperature was subnormal on the day after admission, and did not rise again at all. The pulse throughout was steady and of very good quality. On the third day after admission he began to become definitely jaundiced, and although this deepened gradually, it was never severe.

His condition on the morning of September 25, 1924, was quite satisfactory, and he appeared to be doing well, but in the afternoon he suddenly collapsed and died. There was no trauma, and he had not been vomiting at all that day.

In view of the suddenness of his collapse and death, a post-mortem examination of the body was held next morning, and, on opening the abdomen, it was found that there had been a severe hæmorrhage into the peritoneum, the blood being found mostly on the left side. The spleen was carefully removed and examined. It was enlarged and tense, weighing 1 pound $1\frac{1}{2}$ ounces; and a tear one inch long was found on the lower border. Smears were taken from the spleen substance, and showed the presence of large numbers of benign tertian rings. No malignant tertian parasites were found.

With the exception of some thickening of the mucosa of the small intestine and an abnormally full gall bladder, the other abdominal organs were normal.

In the chest the pleura on the right side was adherent practically all over, and a little fluid was present in the left pleural cavity. The heart was normal.

The brain was removed and examined, but showed nothing abnormal.

It was concluded that death was due to spontaneous rupture of the spleen, probably caused by a sudden enlargement of the organ rupturing the capsule.

The above notes are published at the suggestion of the Director of Medical Services in India, on account of the rarity of spontaneous rupture of the spleen in malaria.

The following note of a somewhat similar case, which has been extracted from an official report by Major G. G. Tabuteau, the Surgical Specialist at Murree, may be of interest.—(*Eds.*)

The patient, a Gunner of the R.F.A., was detained at Lower Topa on the evening of June 4, 1924, with a temperature of 103° F. He had a story of a recent attack of benign tertian malaria.

On June 7 the patient complained of pain all over the abdomen, which was tympanitic. He was transferred to the British Station Hospital, Murree, and admitted for further treatment.

When seen at 9·45 p.m. his temperature was 96° F. and the pulse was

144—very weak and streaky. He still complained of very severe pain all over the abdomen. On inspection, the abdomen moved with respiration, but was rigid and very tender. Abdominal reflex was present. There was no loss of liver dullness, and no tumour could be felt. His condition rapidly became worse, and it was decided to perform an exploratory operation. Laparotomy was performed through the right rectus border (inner) incision. On opening the abdominal cavity it was found to be full of fresh blood. On passing the hand into the abdominal cavity the spleen was felt to be very soft and friable, though not a very large spleen. The patient's pulse completely failed on the table. The wound was quickly closed and no further surgical interference attempted. The patient was put back to bed and hot-water bottles applied, etc., but he died in about one and a half hours.

June 8.—On post-mortem examination the abdomen was found full of blood and enormous clots. The spleen was completely pulped, and weighed nine ounces. There was no appearance of external trauma. The rest of the organs appeared normal.

A SMALL OUTBREAK OF PNEUMONIC PLAGUE.

By Major ALEXANDER HOOD.
Royal Army Medical Corps.

Primary pneumonic plague is a relatively rare disease, and being one of the most infectious and fatal diseases is of personal interest to every medical man liable to meet it. On his prompt recognition of the condition his own safety and that of the other attendants on the sick depend.

A recent letter [1] on this subject pointing out the danger to doctors and nurses has prompted this note.

Pneumonic plague may be primary or secondary to other forms of plague, but is obviously more dangerous to the attendants.

An outbreak of primary pneumonic plague occurred among the Indian servants of the Soldiers' Home, Upper Topa, Muree Hills, India, some years ago and the history of the outbreak may be of interest and help to others.

On the evening of September 22 (19 ?) a sick man arrived at the servants' quarters of the Home from Rawalpindi; he was a hill-man like most of the servants of the Home and he was brought into the servants' quarters where eight servants sat with him all night. On the following morning, early, he was carried off on his charpoy and his further history is unknown. There was plague at that time in Rawalpindi and in view of later events it is probable that this man had secondary pneumonic plague; had it been primary he would scarcely have survived the journey. On the evening of the 24th, the eight servants who had sat with this man were complaining of "fever." I was called to see these patients on the morning of the 25th; the history one got before seeing them was, simply, that the previous

evening these men had gone off duty complaining of "fever"; nothing was said about the sick visitor of forty-eight hours before.

As soon as one entered the first patient's "go-down," the likelihood of an infectious pneumonia presented itself and one departed hurriedly to don mask, gown and gloves before making a further examination. The reasons for this were, firstly, the sputum, which was unlike any sputum one had ever seen before, resembling pure serum streaked with blood and slightly frothy, was being deposited all over the floor of the room: secondly, the look of horror on the patient's face, not a look of anxiety, but sheer dread. Properly garbed, examination showed all eight to be in much the same condition, the sputum varied in quantity, but it showed the same characters and in one case was extremely copious.

The look of horror was present in all in different degrees; the first patient seen showed it most strikingly, or possibly one became more accustomed to it.

The physical signs in the chest were in all cases well marked, coarse bubbling râles being a feature. No buboes were present in any of the cases.

The progress of the disease was dramatic, there was intense dyspnœa and prostration, and by September 27 all eight cases were dead.

The diagnosis had been confirmed by finding the sputum full of *Bacillus pestis*.

Common-sense precautionary measures sufficed to protect all the attendants on the sick and the surrounding population, but they were carried out rigorously as soon as the patients were seen, e.g., sentries were posted at all entrances to the grounds of the Home and a system of supply was organized for the occupants of the Home.

The isolation of the patients was simplified by the fact that the servants' quarters were well separated from other buildings.

It was remarkable with what celerity these and other measures recommended were carried out when the full significance of the outbreak was put before the O.C. Station. No further cases occurred.

The outbreak is of interest because it was so definite. The infection could only have come from the sick man passing through . . . there were no other plague cases nearer than Rawalpindi, forty miles by road. The incubation period was less than forty-eight hours, and strict isolation and careful protection of the attendants controlled the disease at once. The points on which the diagnosis was based (prior to bacteriological examination) were :—

(1) Eight persons closely associated with each other going down with pneumonia at the same time.

(2) The character of the sputum less than twenty-four hours after the onset.

(3) The look of horror.

REFERENCE.

[1] *Brit. Med. Journ.*, December 27, 1924, Correspondence.

Current Literature.

Memorandum circulated for the use of the Medical Staff. Med. I. New Series, No. 76 (Ministry of Health).—The following abstract of a paper, prepared in response to a questionnaire from the Office International d'Hygiène Publique by Dr. P. G. Stock, in collaboration with Mr. M. A. C. Hinton of the Natural History Section of the British Museum and Dr. K. Jordan of the Zoological Museum at Tring, is circulated for the information of the Medical Staff:—

THE SPECIES AND VARIETIES OF RODENTIA AND OF THEIR CUTANEOUS PARASITES WHICH MAY BE CONCERNED IN THE SPREAD OF PLAGUE IN GREAT BRITAIN.

PART I.

Species and Varieties of Rodentia.

At the present time there are neither cases of human plague nor any known epizootic amongst rodents in Great Britain, but in those outbreaks which have occurred in the past the rodentia generally associated with them have belonged to a subfamily of the Muridæ—the Murinæ.

Besides some native wild Muridæ, Great Britain possesses three species which have been introduced at different dates from abroad; these aliens are the black rat (*Rattus rattus*), the common rat (*Rattus norvegicus*), and the house mouse (*Mus musculus*).

The living British Muridæ belong to the sub-families Microtinæ and Murinæ.

The MICROTINÆ or voles are represented in Great Britain by five species, viz.:—

The bank vole (*Evotomys glareolus*)—distributed throughout the country.

The short-tailed field vole (*Microtus hirtus*)—distributed throughout England and the Lowlands of Scotland.

The Highland field vole (*Microtus agrestis neglectus*)—distributed in the Highlands of Scotland.

The common water vole (*Arvicola amphibius amphibius*)—distributed throughout England and the Lowlands of Scotland.

The Highland water vole (*Arvicola amphibius reta*)—distributed in the Highlands of Scotland.

The bank vole (*Evotomys glareolus*) is sometimes found in houses, but as far as is known none of the Microtinæ have ever been associated with plague in Great Britain. Whether under special circumstances some of the species might be concerned in the spread of plague is another matter. It is improbable, however, that they would ever be an important factor in the spread of the disease.

re represented in Britain by three genera :—

field mouse (*Apodemus sylvaticus*)—distributed through-
ınd Ireland.

ı field mouse (*Apodemus flavicollis wintoni*)—distributed
ngland.

use (*Micromys minutus*).

regard to the association of the Microtinæ with plague above species of the Murinæ, but the following alien lefinitely concerned in the spread of plague :—

R. *rattus*).

ıt (*R. norvegicus*).

se (*M. musculus*).

AT (*R. rattus*) may be divided into three subspecies,

ıt (*Rattus rattus rattus*).

chnically the type of the species, is essentially charac- the cold temperate countries of Europe.

drine rat (*Rattus rattus alexandrinus*).

ılly characteristic of Asia Minor and North Africa—and tree rat (*Rattus rattus frugivorus*).

ılly a wild-living rat inhabiting the Mediterranean ıerally.

have been conveyed by human commerce to the various d. Wherever colonies of *R. rattus* are established in *us* and *frugivorus* are to be found.

R. *rattus*) appears to have been brought to Great Britain ıe Crusaders, but with the arrival of the common rat ıe early eighteenth century it was killed out, and save for nies[1]—continually replenished or re-established by ship ›ears to have become extinct in this country shortly the nineteenth century.

ıent century, however, the species has shown a well- › re-establish itself in Britain. It is constantly arriving ur ports. The substitution of solid buildings of stone basements made rat-proof against the inroads of the *rvegicus*), for buildings of an older and less substantial eeding steadily during the last twenty-five years in all This substitution, coupled with the introduction of the n *R. rattus* a new chance. Rat-proof basements keep rain-haunting, rival rat (*R. norvegicus*), thus protecting petition ; and telephone wires stretching from roof to marily arboreal species to colonize one new building

---

ɔwn colonies of *R. rattus* living in Britain is that discovered at [r. A. H. Patterson.

after another. Roof kitchens and restaurants have been established in many of the larger modern buildings ; and in many of these colonies of black rats have been established during the last few years, often at considerable distance from dock-side. Thus in London we have had instances of such colonies in Whitehall, the Strand, Holborn, Brompton Road, Hammersmith and in North London.

The common rat (*R. norvegicus*) came to England probably by ships trading with Russia in 1728 or 1729. It is not known to have occurred in Scotland before 1764. It is developing a black race—described originally from Ireland in 1835—*Mus hibernicus*. This black race, which is frequently confused with *R. rattus rattus*, is becoming commoner and acquiring a wide distribution.

In addition to the rodentia belonging to the family Muridæ, Mr. Hinton has drawn attention to the possibility of squirrels (*Sciurus*), particularly the American grey squirrel (*S. carolinensis*) which is now spreading all over Britain, being associated under special circumstances in the possible spread of plague.

It may also be convenient to refer here to an outbreak of rodent plague in East Suffolk which occurred in 1909-10.[1]

During this outbreak, in addition to a number of rats which were proved to be infected with plague, two hares (*Lepus europæus*), two rabbits (*Pryctolagus curriculus*), a ferret (*Mustela*), and a cat (*Felis domestica*), were found to be infected with plague. Under certain circumstances therefore hares (*Lepus*), rabbits (*Pryctolagus*), cats (*Felis*), and ferrets (*Mustela*), might come under suspicion and possibly be concerned in the spread of plague.

In this connexion, too, other fur-bearing British mammals such as bats, shrews, moles, and various carnivora (foxes, badgers, stoats, weasels, polecats, martens and others) should be borne in mind as possible carriers; although in all probability none of these species will ever deserve to be regarded as an important reservoir of plague.

Part II.

Cutaneous Parasites found on Rodents in Great Britain which may be concerned in the spread of Plague.

This portion of the report does not lend itself to abstract. It includes reference to the species of fleas found in East Suffolk and Cambridgeshire, 1909-11, and gives the following table of fleas which, according to the late Dr. Bacot (Entomologist of the Lister Institute) are more or less frequently found on rats in Great Britain :—

[1] See Reports of the Local Government Board (New Series, No. 52), 1911.

Name of flea	Probable normal host	Distributions
Xenopsylla cheopis [1 2]	Rats	On shipping, buildings in docks, riverside wharves, etc.
Ceratophyllus fasciatus [1 2]	Rats	The commonest species on rats
mustelæ [3]	Voles and field mice	—
londiniensis	[Domestic mouse—K. J.]	—
penicilliger	Voles and field mice	—
gallinæ [1]	Fowls, tits, &c.	—
walkeri	Stoats, etc.	—
Ctenophthalmus agyrtes [2]	Voles and field mice	Next to *fasciatus* the commonest species on rats found in the open
bisocto-dentatus	Mole	—
Rhadinopsylla pentacanthus	Weasel [voles and mice—K. J.]	—
Spilopsyllus cuniculi [1]	Rabbit, hare	—
Leptopsylla musculi [1 2]	Domestic mouse	—
Ctenocephalus felis [1 2]	Cat or dog	—
canis [1]	Dog or cat	—
Pulex irritans [1 2]	Man, badger	—
Archæopsylla erinacei	Hedgehog	—
Hystrichopsylla talpæ	Moles [shrews—K. J.]	—
Palæopsylla minor	Mole	—

[1] Known to bite man. [2] Proved carriers.
[3] Not known to me to occur on rats.—K. J.

Bacot states that: "In the absence of exact knowledge and in the light of what is already known concerning the carriage of plague by fleas and the range of this disease among rodents, practically all the species mentioned must be considered as possible vectors in an epizootic, though only a few of them call for attention in relation to the spread of plague to man."

The species of fleas and the distribution of rats in Liverpool, 1920-21, are summarized and somewhat similar tables for 1922-23 in regard to Cardiff are also included. As an appendix, Dr. Jordan has prepared a list of the seventy-nine fleas found on rats based on the Rothschild collection.

Principles Adopted for Electric Lighting in H.M. Naval Service, being the First Report of the Admiralty Lighting Committee. H.M. Stationery Office, London, 1924. 39 pp. Price 9d. net.—This report of a Committee appointed by the Lords of the Admiralty covers a wide field in illumination as applied to H.M. ships and shore establishments. The subject is extremely complex, and it has been found difficult to apply theoretical data to the great variety of conditions in ships and establishments. As some time will elapse before their experiments will be completed and full recommendations can be made, the Committee have thought it desirable to issue a first report without delay.

In the introduction, Section i, the Committee make the significant statement that "many persons are attracted by excess of light and brilliant lighting units and regard a place as well illuminated because a large number of naked lights are visible, while on the other hand there are those who maintain that 'totally indirect lighting,' in which only reflected light

from walls and ceilings is used, is the ideal. Both these extremes are bad and may be productive of eye-strain."

Section ii is devoted to medical considerations, and the aim from the medical standpoint should be to avoid insufficient or excessive light, brilliant points of illumination in the line of vision, shadow on the work, excessive contrasts, and reflection of direct light into the eyes from bright surfaces.

In order to render intelligible the recommendations contained in this report there follows in Section iii a brief account of the theory of illumination in which candle-power, lumen, foot candles, watts per candle, etc., are described.

Section iv contains the recommendations of the Committee, forty in number. They say that a higher standard of illumination is desirable in H.M. ships, and consider that three to five-foot candles is a good average for most purposes. Except for specific purposes, the use of unshaded lights and clear glass globes should be discontinued. Lamps suspended sufficiently high need not be shaded; other lights should be screened so that no naked light is visible within an angle made by two lines from the eye, one being horizontal and the other at forty degrees to the horizontal. No part of a lighting unit normally within the range of vision should have a surface brightness exceeding 2·5 candle-power per square inch. Shallow conical shades should be discontinued, and crinkled, frosted, etched, clear-moulded or cut-glass shades are not recommended. A glass shade should be translucent and just sufficiently dense to prevent the outline of the filament from being seen too clearly through the glass. The use of totally indirect lighting is not recommended, as the absence of a reasonable degree of shadow and contrast leads to strain and fatigue. Where general illumination and local illumination are used, the general should not fall below twenty per cent of the local illumination. Contrasts greater than 100 to 1 are undesirable. Lighting should be so arranged that a shadow does not fall on the work. For desk work it is desirable to place the light, efficiently shaded, not less than two feet six inches above the working plane. Gas-filled tungsten lamps should be used for large units and vacuum tungsten lamps for smaller units. Carbon filament lamps should only be used where there is likely to be excessive vibration owing to gun-fire or other causes.

The illumination values recommended for H.M. ships are contained in Appendix No. 1, and a technical description of general principles of light and illumination is given in Appendix No. 2.

The pamphlet cannot fail to be of service to those responsible for the lighting of H.M. ships and naval establishments, and we look forward to the complete report which will be issued when the Committee's experiments are completed.

Reports and Analysis.

"HYPOLOID" BISMUTH METAL.

"HYPOLOID" Bismuth Metal in Isotonic Glucose Solution (0.2 grm. in 1 c.c.) is prepared by Burroughs Wellcome and Co. to provide specialists and general practitioners with an additional weapon in their campaign against syphilis.

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The required dose is drawn up direct into the syringe barrel by puncturing the rubber cap with the syringe needle and withdrawing the piston to the requisite mark on the barrel. On withdrawing the needle the aperture in the rubber cap closes automatically and reseals the container.

Burroughs Wellcome and Co. announce two sizes of "Hypoloid" Bismuth Metal in Isotonic Glucose Solution, No. 556—5 c.c. rubber-capped bottles and No. 557—10 c.c. rubber-capped bottles. The commencing dose suggested is 1 c.c. at each injection.

Reviews.

AN X-RAY ATLAS ON THE NORMAL AND ABNORMAL STRUCTURES OF THE BODY. By Archibald McKendrick, F.R.C.S.Ed., D.P.H., and Charles R. Whittaker, F.R.C.S.Ed. Edinburgh: E. and S. Livingstone. 1925. Demy quarto. Pp. xvi + 222; 388 figs., 104 plates, 25s. net.

This is the third book on somewhat similar lines produced during the last year and it is extremely well got up and printed on very good paper.

Many of the figures are of considerable educational value, while others, even allowing that they are reproductions, are very indistinct and blurred.

Much good work is lost when similar figures especially of tuberculous bones are scattered throughout the section instead of being collected together.

The descriptions of many of the figures are scanty, only final radio-diagnosis being given. This may be satisfactory for experienced radiologists but is of little use to the beginner or for those who have little time for deducing the various points of a radiogram.

Many of the figures are not the only form in which the specified conditions appear.

The Section on Technique and Positions is good, although the often referred to "Normal Positions" are presupposed.

Altogether the authors have produced a useful book and have attempted to cover an enormous and ever increasing field as well and as far as they could, consistent with keeping the volume within reasonable size.

D. B. McG.

THE EXAMINATION OF WATERS AND WATER SUPPLIES. By John C. Thresh, D.Sc., M.D., D.P.H., and John F. Beale, B.A., M.R.C.S., L.R.C.P., D.P.H. Third edition with 59 illustrations. London: F. and A. Churchill. 1925. 25s. net.

We welcome the third edition of this excellent book. It is in a class apart and we do not know of any other work on water supplies which gives quite the same information.

The new edition prepared by Drs. Thresh and Beale contains special information on the hydrogen-ion concentration in various waters; the utility of the determination of the electric conductivity; the action of water on lead; the numerical estimation of colour, turbidity, etc.; the action of water on zinc; the removal of iron; the purification of water by sand filtration, by the action of chlorine and by excess lime-treatment.

The experience gained during the war on the use of chlorinated water derived from practically every source has necessitated a reconsideration of what is to be regarded as a wholesome water. Heavily polluted waters, after chlorination, were used in France for long periods without any manifest detriment to health, and as a result of this experience it is now agreed that after chlorination waters may be used which in times gone by would have been condemned as quite unfit for consumption. The chapter on what constitutes a pure and wholesome water is of great practical importance and should be carefully studied by all who are responsible for the supply of water to either civil or military communities.

The purification of water by chlorination is dealt with in Chapter X, and detailed information is given as to the practice of several water companies which have adopted the process; we notice that one company is employing chlorine and ammonia recently advocated by Major Harold and Captain A. R. Ward in this Journal.

For the treatment of impure waters, Drs. Thresh and Beale appear to prefer the excess lime treatment advocated by Sir Alexander Houston, as it removes 50 per cent of the organic matter present. They have carried out many experiments with an installation provided by the Southend Water Co., and the excess lime process is now being used at Chelmsford and by the Southend Water Co. It has peculiar advantages when the water requires to be softened as well as purified.

In the chapter on the treatment to prevent the action of water on lead, it is pointed out that the addition of a solution of sodium silicate is most

effective since it actually prevents the oxidation of lead and apparently also retards the oxidation of other metals of which pipes are made.

The electrical conductivity of a water depends almost entirely on the substances dissolved in it, and the determination of the conductivity is very useful in a laboratory where many examinations of samples from the same source are being made. Any change in the composition will be indicated by a change in the conductivity. Its determination is also very helpful for ascertaining the quality of distilled water, one with an E.C. about two should be used for water analysis. The proportions in which waters are mixed can also be easily determined from the values of the respective electrical conductivities. The method of determining the E.C. is fully described in Chapter XXIII.

The interpretation of the results of chemical analyses is discussed in Chapter XX, which we regard as one of the most valuable in the book.

In the chapter on the softening of water full information is given as to the method of determining the amount of lime and sodium carbonate required, lime water is preferred to milk of lime and brilliant cresyl blue is recommended for the determination of excess lime. The same indicator is used to ascertain the amount of lime needed to give an excess which will destroy *Bacillus coli* and other bacteria. The authors state that one grain of excess lime per gallon with twenty-four hours' contact invariably destroys *B. coli* in river waters and such water gives a green tint with brilliant cresyl blue. The excess lime is removed by agitation with air containing free CO_2 before it is safe to turn the treated water into the mains; the water is passable when it gives a blue colour with brilliant cresyl blue.

The question of the presence of zinc in a drinking water assumed considerable importance during the war, as water was conveyed to the troops by galvanized iron pipes. Dr. Thresh made extended investigations into the matter and found that zinc was frequently present in drinking water when the service pipes were made of galvanized iron. Zinc mainly in the form of bicarbonate is often present to the extent of 0·3 to 1 grain per gallon, and waters containing as much as two grains per gallon are being used and apparently with impunity. Zinc is not a cumulative poison and appears to be rapidly excreted. Dr. Thresh considers it is not advisable to use a water containing more than 0·5 part of zinc per 100,000, and though such a water might be regarded as impure he is doubtful whether it could be considered unwholesome. The action of water on zinc can be prevented by passing it through chalk.

The interpretation of the results of the bacteriological examination of water and the methods employed in such an examination are dealt with in the last two chapters of the book. The authors regard bacilli which ferment glucose and lactose in bile salt broth with the formation of acid and gas, produce indol in peptone water, and acid and clot in milk, and do not liquefy gelatine, as *B. coli* characteristic of sewage contamination and with this view we agree. Streptococci they consider of no particular

significance, but as they are never found in pure wa
especially when present with *B. coli*, as additional
contamination, though not necessarily indicators
contamination.

A water which does not contain *B. coli* in 100
considered to be of the highest bacterial purity, w
B. coli in five cubic centimetres is regarded as probabl
manurial matter and should not be used for drinki
thorough examination of the source has proved that
is impossible. As regards private supplies from wel
water which is free from *B. coli* in ten cubic centi
contain more than 1,000 bacteria per cubic centimetre
may be used provided the medical officer of health
source of contamination. In these circumstances
scopical examinations are considered to be of
should prefer to chlorinate such doubtful supplies
not available.

In the recognition of *B. typhosus* a dilution of ant
least 1—50 is recommended. While such a dilution
presumptive test, it is not sufficient, as we have found
typhoid excreta which are agglutinated by anti-ty
1—100. A recent agar growth of the supposed *B. ty*
with the serum in the highest dilution at which it ag
B. typhosus.

The preparation of bacteriological media is describ
and we notice that the reaction is adjusted to pH 7·
as in the previous edition.

The volume is well printed and illustrated by num
of the microscopical flora and fauna of water. It shou
library of every hygienist and water engineer.

NATURE OF DISEASE. By J. E. R. McDonagh. Lon
1924. Part 1. Pp. 327. Price £3 3s.

This book may be considered under three headings

(1) The theory on which it is founded.
(2) The subject matter of the book itself.
(3) The practical application of the theory.

(1) The theory on which it is founded is the "ele
valence" of Shipley Fry: a theory that has many
some interest. There are portions of the book whic
understand without at least a nodding acquaintance
ideas, and even then the author's general conclusi
signs of disease (using the word in its broadest sense
the normal conditions of health and well-being) are
in the electrical potentiality of the body protein molec

The whole theme is so bizarre that it is difficult to expound in any way but *in extenso.* In substance the hypothesis premises that the basis of all disease is an alteration of the electrical charge of the protein molecules, which in turn produces clinical and pathological signs and symptoms, except in the case of pyrexia, which is ascribed to a liberation of free electric charge.

(2) The subject matter of the book itself. This is made more difficult of comprehension by the use of words which have no precise scientific meaning, and which fail to convey the author's ideas. It would have been better to have coined new words, appending a glossary as necessary, rather than to have fogged the thesis by vague terminology. The general sequence of the chapters is not above criticism, for instance, Chapter VII, which is a vital one dealing with the nature of conductors and condensers and their effect upon the general protective mechanism of the body as conceived by the author, might well have come much earlier in the book. The opening paragraphs of the section headed "Nature of Vehicle" (p. 211) are somewhat abstrusely worded and very difficult to follow; especially so in Chapter XIII which deals with chemotherapy.

(3) The practical application of the theory. First, the application of the electronic theory of valence to a physico-chemical explanation of the problems of disease; and, secondly, the treatment of disease on the lines suggested by this application. The application of the electronic theory is controlled by microscopical examination of tissues (after the administration of "conductors" or "condensers") stained in special ways according to Chapter III, and by certain tests applied to the blood, vide Chapter VII. The treatment of disease by the administration of substances which are either "conductors" or "condensers," i.e., which are said to absorb or to give up electrical charges in accord with the primary electronic theory, is the main thesis of the book.

Apart from these criticisms the subject matter, despite the difficulty in grasping a new and strange conception, is attractively set forth. The book is nicely produced and the illustrations and index are of a high standard of excellence.

Readers must form their own opinion upon the vital question as to whether the microscopical findings and the suggested blood-tests are any proof that the changes observed are either the result of the surmised electronic alterations, or are in any way connected with the causation of disease.

The book contains the complete enunciation of an entirely new conception of disease, and as such merits consideration and thought. New ideas are not so plentiful that medical science can afford to discard them lightly.

INDEX TO VOLUME XLIV.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

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Original Communications.

AN ANALYSIS OF THE PRESENT STATE OF OUR KNOWLEDGE RELATING TO *ENCEPHALITOZOON*.

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(Continued from p. 410, *Vol. XLIV.)*

OCCURRENCE OF THE PARASITES IN OTHER ANIMALS.

IN their account, Verrati and Sala, according to Da Fano [7], drew attention to a paper by two other Italians, Maggiora and Garofani, who, some years ago, observed in the brains of two geese, used for other experiments, a few cysts filled with parasites very like those under consideration. This note of their occurrence in birds is, so far, the only reference to the observation of the organisms in groups other than mammals. But it is now well recognized that *E. cuniculi* (or else a closely allied species) occurs in other rodents than the rabbit. A good description of the existence of a meningo-encephalitic condition and the same kind of parasite in mice has been given by Cowdry and Nicholson [5]. Very much the same state of affairs was found by these workers in mice as is to be noted in rabbits. The lesions were found in twenty-five out of 132 mice examined, i.e., in about nineteen per cent. The infiltrations were observed in all parts of the brain, but were most frequent in the cerebral cortex. Focal areas were most common in occurrence and often found alone. Perivascular, meningeal and subependymal infiltrations were rarely seen apart from the focal ones. An important point was ascertained from the study of serial sections, namely, that there is often continuity between a meningeal infiltration on the surface, its extension into the brain as a perivascular

infiltration and its termination as a focal lesion, either at the end of the penetrating capillary or to one side of it. The same kinds of cell were found to participate in the infiltrations, irrespective of their type. Lymphocytes predominated, but plasma cells and macrophages were also noted. The latter were most numerous in the case of focal lesions with central zones of necrosis. Polymorphonuclear leucocytes were always scanty.

The youngest mouse in which an infiltration was noted was only two days old. Both lesions and parasites were abundant in another mouse, three weeks old. This was the only one positive out of a litter of six, reared under identical conditions. On the other hand, four mice kept in association, which received doses of *botulinus*-toxin, all showed the lesions and one of them parasites as well, a significant observation. The lesions were also observed in adult mice.

The parasites were detected in twenty per cent of the mice exhibiting meningo-encephalitic lesions, i.e., only in five out of the twenty-five. They were never seen in brains in which no lesions were observed. They were closely associated with all types of infiltration except the meningeal. Their much greater tendency to accumulate in focal areas rather than in prominent perivascular infiltrations—where, however, they do occur—may be explained on the supposition that they escape more readily from the blood-vessels of finer calibre. But many parasites were also found some distance away from the lesions and surrounded by nerve-cells, neuroglial elements, etc., which showed no reaction to their presence. It is interesting to note an element of uncertainty underlying Cowdry and Nicholson's reference to the "cysts," so-called, the authors say, by Levaditi, Nicolau and Schoen. They prefer to regard them as clumps or masses, walled-in by a membrane, or pseudo-membrane. As many as six of these "cysts" could be found together in close apposition. And the important point is that Cowdry and Nicholson, after mentioning the customary occurrence of a large, pycnotic nucleus at one side, say: "from the size, relations and the presence of large, solitary and well-formed nucleoli, it seemed clear that we were dealing with greatly distorted nerve-cells." (I would here interpolate that the parasites in the mice, as found by Cowdry and Nicholson, are distinctly of the elongated type first described and not like the forms of Verrati and Sala, and Cameron and Maitland.) Unfortunately, Cowdry and Nicholson do not definitely conclude that the clumps of parasites are actually intracellular in nerve-cells although, after weighing the pros and cons, they appear rather more in favour of, than against this view.

Nothing specially new in regard to the parasites themselves is described; a tabular comparison is made with the observations of other authors.

Cowdry and Nicholson are evidently somewhat exercised in mind as to how to explain the much more frequent occurrence of the lesions than of the parasites, and they suggest that the *Encephalitozoon* may produce the lesions, which persist after the organisms have, in many instances, disappeared. In this connexion they recall the observation by Smith and

Johnson of similar infiltrations in the kidneys of mice, which these authors thought to be due to old foci of infection with the coccidian, *Klossiella muris*, persisting after the parasites had been set free. (Cowdry and Nicholson agree that there is here no question of *Klossiella* being concerned.)

Nevertheless, Cowdry and Nicholson are the first workers to hint at the possibility that the lesions are not solely and entirely due to the *Encephalitozoon*. They remark that: "though the parasites may be capable of producing them, and probably actually do so in many cases, it must be admitted that the evidence at hand does not preclude the possibility of the operation of other factors." The authors note the non-specific character of the lesions, from the standpoint of histo-pathology, and think it is not unlikely that infiltrative lesions of this general nature may arise in more than one way. The authors, after referring to McCartney's statistics (cf. above) point out that they also found the lesions were present only in ten per cent of normal mice, but in thirty-one per cent of animals used for experimental methods. And they briefly refer to Twort and Archer's suggestion that the lesions may be caused by the action of a filter-passing virus, without, however, making any comment thereon. It is evident from the summary of their conclusions that they regard the condition as being produced, in general, by the parasites, either one and the same species being concerned in both mice and rabbits, or else slightly different varieties in the two cases respectively; and the possibility that the alleged parasites may be on the contrary products of the reactions of the cells to a virus of a nature as yet unknown, is not alluded to by them.

The authors note that they also found similar lesions in a very small proportion of guinea-pigs and rats examined; namely, in 4 out of 105 guinea-pigs, and in 1 out of 114 rats; but in no case were any parasites observed.

In the course of writing this review, I have seen what is, perhaps, the latest paper to date on the subject, an interesting account by Smith and Florence [27] of the lesions and parasites in the kidneys of the rabbit. In a total of 163 autopsies, forty-five cases were found. I take this as referring to the number showing parasites, for no definite distinctions are drawn between rabbits with lesions and those with parasites; if this conclusion is correct, the percentage of positive infections—over twenty-five per cent—was very high. In almost half the cases the organisms were associated with coccidiosis of varying severity, and in three cases with salivation or "slobbers." Smith, it may be noted, was one of the discoverers of the coccidian (*Klossiella*) in the kidney of the mouse, referred to above. And while he and Florence also regard *Encephalitozoon* as a quite distinct organism, they consider, nevertheless, that it and the related pathological condition seen afford a certain parallelism with the case of *Klossiella*.

As regards the habitat of the parasites, the epithelial cells of the collecting tubules near the tip of the papilla, and even these covering the

ɜquently invaded. Next in order come the loops of were the parasites seen in the convoluted tubules, and n epithelial cell of a Bowman's capsule. Seen in the anisms appear either as pale, or more highly refractile like outline with rounded ends; they vary from 2·5 to 3 y 1·5 to 2 microns in width. These are regarded as the Their number may vary from five to sixty or more, ich does not include the entire cell. The organisms in a cell-vacuole, and the cell may thus sometimes as to fill the lumen of the tubule. Smith and Florence, tentatively admit that, from this stage alone, the that the organism is a non-cultifiable bacterium—an uld scarcely be made if these bodies possessed the re and features of a true microsporidian spore.

s, too, like Levaditi, Nicolau and Schoen appear to pay to the characters of the spore—the essential criterion ffinities of a sporozoan parasite—and are, apparently, pied in the endeavour to recognize something which lentify as a "pansporoblast" (the inverted commas are hors—quite unnecessarily if they are dealing with the the microsporidian life-cycle designated by this term). e consider they have been successful in this respect of roundish masses of granular cytoplasm, permeated -staining bodies, in certain of the epithelial cells in a old, which had a heavy infection. These bodies to 14·4 microns by from 16·2 to 19·8 microns. More- ound what they regard as a later stage (early spore mina of the loops of Henlé, and, more rarely, in the In some tubules these bodies were numerous enough n. They consider that such pansporoblasts have been by the disintegration of the host-cell. It must be hat the vague and indefinite masses shown in Smith and g. 5, pl. ii) do not conform at all closely to the typical pansporoblast of a known Microsporidian. These agree, are in all likelihood the same as those described and by Da Fano (*vide supra*).

nce are inclined to consider that a "vegetative" or (representing the endogenous part of the life-cycle) is in the kidney. They look upon this site as the normal the parasites met with in the brain as of more or rrence, or representing aberrant forms, not correspond- phase in the cycle. (This view does not accord well s of other workers, and goes to show, I think, how l is what life-cycle, if any, there really is.)

ce express themselves as being somewhat uncertain in

regard to the exact relation of the focal lesions to the parasites, both in the kidney and in the brain. In the latter, they also found the situation of the parasite to be in the nerve-cells, "which are filled with the spore-like bodies, and without a trace of reaction around them." One such clump measured forty-eight microns in diameter, and probably contained several thousands of spores! The authors say that the total absence of any host-cell reaction around the infected cells is characteristic of many protozoan infections. All the same, they are inclined to assume that the lesions may be accounted for by the dissemination of the trophozoites or other stages of coccidia, and perhaps by bacterial infection, etc. (The first of these assumptions appears to me to be a most unlikely explanation of the brain-lesions, in which no phase of a coccidian has yet been observed by any worker.)

EXPERIMENTAL INOCULATION INTO RABBITS AND OTHER ANIMALS.

Certain experiments in transmission, which have a most instructive bearing on the subject, have been made by Levaditi, Nicolau and Schoen. These workers have been able to inoculate brain-material containing the organisms intracerebrally into rabbits, with subsequent production both of lesions and parasites, not only in the brain but also in the kidney, and even in the kidney alone. Similarly, positive results were obtained by inoculation of renal emulsions into the encephalon. Various other modes of inoculation were also successful. Further, the urine, containing the spores, is infective, either by intracerebral inoculation or by way of the digestive tract. This latter fact explains (or may explain) the occurrence of contaminative infection, i.e., among animals kept in the same cage. Yet it is a little odd that in each of the two series of experiments detailed only one of the two rabbits exposed to infection gave positive results, both as regards lesions and parasites.

Levaditi, Nicolau and Schoen were unable to obtain infection after filtration of the brain-emulsion (this negative result agreeing with that of similar experiments by Cameron and Maitland), and they conclude, contrary to the view of Twort and Archer, that the virus is not a filter-passer; in other words, that the parasites have no minute stage capable of passing through a filter (cf. below, p. 7). Cameron and Maitland (loc. cit.) found that inoculations of a suspension of brain-material, known to be positive, into the abraded cornea, or into the anterior chamber, were unsuccessful in producing any infection with the parasites.

Various other animals were successfully inoculated by Levaditi, Nicolau and Schoen; though as regards certain of these instances the possibility cannot be ignored that the parasites were already present. In the case of one guinea-pig a single spore was found in the kidney. In a dog, inoculated intracerebrally, death occurred on the twenty-second day and numerous parasites were found in the brain.[1] Cameron and Maitland also conclude,

[1] As this article is about to go to press, Dr. Arkwright has kindly drawn my attention to a paper by Kantorowicz and Lewy, on pathological observations and the occurrence of parasites in nervous distemper in dogs (*Arch. wiss. Prakt. Tierheilkunde*, 49, 1923, p. 137). In

experiments, that the parasite is at least capable of
In the case of mice, the French workers point out that
lure is very liable to yield inconclusive results, because
y large positive percentage (70 per cent) in apparently
mined; this was much higher than the percentage of
turally infected by Cowdry and Nicholson. It may be
rial used for inoculation was very varied, and included
virus preserved in glycerine. (It appears rather a
on to think that microsporidian spores preserved in
e rise to an infection.) The authors found no indica-
e of the parasites in the testis or ovary and conclude
smission is very unlikely.
ound liable to infection after injection of the virus into
. *Encephalitozoon* was found in peritoneal cells, in the
r. It need only be mentioned that the authors found
full of ripe spores, which they consider resulted from
the parasites, which had penetrated into them. And
igure other endothelial cells containing a large body
ranules which is regarded as the pansporoblast stage.
writer quite as likely that these macrophagic cells had
bodies—the *Encephalitozoon* spores—and were digesting

biei, MANOUELIAN AND VIALA, AND HYDROPHOBIA.

sm aroused by their work on *E. cuniculi*, Levaditi,
have boldly suggested [19] that the virus of hydro-
oridian parasite, and they have developed this idea in
20 and 21]. Moreover, Manouelian and Viala have also
d a similar opinion and have published an account of
they regard as a different species of *Encephalitozoon*,
pose the name *E. rabiei* [22 and 23]; their latter
y some highly instructive figures.
ps of workers regard the characteristic and well-known
ing intimately connected with this Microsporidian
very different manner respectively. According to the
egri-bodies represent merely a degenerative condition

cess, compared with an encephalitic condition, peculiar parasite-
ted, definitely in the ganglion-cells. (These recall in many respects
y were found in five out of twenty-two dogs. And the site of the
ous, was characterized by the presence of marked inflammatory
essels, with, it is important to note, considerable cellular altera-
on nor experimental transmission of the parasites was successful.
as certainly a Protozoan and not a product of cell-degeneration;
tfully with *Toxoplasma* (rather an interesting idea), but with more
having Nöller's support for this opinion, with *Theileria* (this, on
ne as very improbable). I certainly think we have to do here with
e as is under consideration in this review.

of the parasites. But, according to Levaditi, Nicolau and Schoen, the Negri-bodies constitute an important phase in the life-cycle, namely, the pansporoblast or cystic phase of a Microsporidian, which they prefer to regard as distinct from *Encephalitozoon* and consider to be a species of *Glugea*, for which they suggest the name *Glugea lyssæ;* incidentally, they entirely ignore the rules of zoological nomenclature in changing the specific name previously given by Manouelian and Viala!

Levaditi, Nicolau and Schoen enunciate a truly remarkable proposition. They consider that the transmissible phase of this Microsporidian is ultra-microscopic and filterable: in this guise it multiplies throughout the nervous system and produces the histo-pathological condition. In addition, however, in the case of the street-virus only (not in the fixed, exalted virus), a definite life-cycle is present, which includes the formation of pansporoblasts, that is to say, Negri-bodies. The inner formations of the Negri-bodies are constituted, according to these workers, by a mass of microsporidian spores so minute that they cannot be individually distinguished. Now, as is well-known, in the fixed, intensified virus, the Negri-bodies, where found, are very scarce and minute. This fact, so unlike the case of a protozoan infection, where the degree of manifestation of the disease is correlated in general with the intensity of the infection, is explained by Levaditi, Nicolau and Schoen on the assumption that in this state the parasite has lost the power to produce pansporoblasts, i.e., the essential sporulating phase for the production of the propagative forms.

The ultra-microscopic form of the parasite is also considered to be present in the salivary glands.

According to these workers, there is nothing at all corresponding to the *Encephalitozoon* spore-phase to be observed.

On the other hand, Manouelian and Viala consider that the *Encephalitozoon* multiplies in the nerve-cells, especially of the horn of Ammon, being often present in numbers in a single cell. But from the authors' figures, the parasites appear to be always scattered or distributed throughout the recognizable cytoplasm,[1] and never form large, compact, cyst-like masses as in the case of *E. cuniculi*. Similarly, the parasite occurs as more or less separate spore-forms in the salivary glands, both in and between the cells, and in the lumina of the acini. According to these authors, the Negri-bodies themselves result from the agglutination of degenerated, more or less homogeneous masses of parasites in the nerve-cells; this is regarded as a special form of reaction exhibited by those cells, which is not induced in the case of the cells of the salivary gland.

I feel constrained to add that, in my opinion, the two accounts above summarized show clearly how requisite is a competent knowledge of proto-

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[1] I must confess that certain of the authors' figures raise a suspicion in my mind that, in the particular instances, the alleged parasites may be, really, Nissl bodies, which (I have myself found) may sometimes assume a quite definite form not unlike that of the corpuscles shown in the figures.

zoology on the part of workers who would associate "bodies"—which are generally considered to be not parasites at all, but cell-inclusions—either with the normal life-cycle, or as degenerative forms of an alleged Protozoan. I have previously [30] given consideration to the question of the real nature of the Negri-bodies, as readers of this Journal may be aware, so that it is scarcely necessary, I think, to deal at greater length with this point here.

General Discussion.

There are certain general aspects of this question, more particularly from the protozoological standpoint, which may be, I think, appropriately envisaged here. Because, although some of these considerations have, naturally, more weight than others, yet, taken together, they do certainly, in my opinion, justify at least an attitude of great caution before regarding *Encephalitozoon* as a Sporozoan.

Comparison of Encephalitozoon with the Sporozoa.—Besides being assumed to be a Microsporidian, of which group *Glugea lophii*, of the angler-fish (*Lophius*) is regarded as being a comparable form, *Encephalitozoon* has also been compared with the Haplosporidia. These parasites constitute a somewhat ill-defined order of the Sporozoa, their general characters including an elementary type of life-cycle and a spore of simple structure, that is to say, not showing a differentiation into polar capsule, etc., in addition to the amœbula (germ).

(*a*) As regards the Microsporidia *sensu stricto*, up to the present, so far as I am aware, no member of the group is known to occur in warm-blooded vertebrates. As regards the Haplosporidia, there are two forms with which *Encephalitozoon* has been particularly compared, namely, *Neurosporidium*, Ridewood and Fantham, which is parasitic in the nervous system of a Pro-Chordate, *Cephalodiscus* and *Rhinosporidium*, Minchin and Fantham, which forms mulberry-like masses and pedunculated tumours on the septum nasi of man. *Rhinosporidium*, however, has been recently stated by Ashworth [1] to be not a Protozoan at all, but a fungus of lowly type, allied to the Chytridineæ; an interesting and important point in corroboration of this view is that the cyst-wall is of cellulose. And it seems highly probable that *Neurosporidium*, which is of very similar type to *Rhinosporidium*, is, therefore, also of fungal nature. Hence, even if *Encephalitozoon* can be compared with either of these two forms, it is in all probability not a Sporozoan.

(*b*) A microsporidian infection is generally very abundant—very much in evidence, that is to say. Numbers—often enormous numbers—of spores are produced, as a result of the great extent to which endogenous multiplication takes place prior to spore-formation. (And the same is true of the Haplosporidia.) The relative scantiness of the organisms and their scattered and diffuse distribution, in the case of *Encephalitozoon*, is very unlike the character of the infection with any of the above-mentioned parasites (cf. figs. 6 and 7).

(*c*) A typical character of a Microsporidian, such as *Glugea,* is the formation of large, conspicuous cysts, visible with a lens, or even to the naked eye, and the same applies equally to *Rhinosporidium.* In this respect not the slightest comparison is possible between *Encephalitozoon* and these two types. The cysts of *Neurosporidium,* however, appear to be more of the order of size of the largest apparent cysts of *Encephalitozoon* ; but the former show very clearly internal multiplication into distinct spore-morulæ (so-called pansporoblasts), each of which produces many spores. This is another marked feature of difference in these two cases. There is, it may be agreed, a certain resemblance between the plasmodial form of *Encephalitozoon,* with numerous chromatinic grains (described above, in connexion with Cameron and Maitland's and Da Fano's work), and *any one* of these spore-morulæ inside the whole cyst, but I think this agreement is only superficial, and does not signify anything.

(*d*) A most important character shown by all the above sporozoan parasites, which is entirely lacking in *Encephalitozoon,* is the occurrence of a thick wall to the cyst. As has been indicated above, where a membrane is present around the apparent cysts of *Encephalitozoon* it is very delicate, and is considered by most workers to be nothing more than the persistent remains of the host-cell. Here, again, therefore, no comparison can really be made in the two cases.

(*e*) The character of the spore is neither that of a true Microsporidian, nor of one of the haplosporidian forms mentioned above. None of the published figures show a recognizable polar capsule so constant and definite in a microsporidian spore; neither have I myself observed anything like one (cf. figs. 3-5). Moreover, Levaditi, Nicolau and Schoen, in spite of all their work on the parasite, do not appear to have made any attempts to obtain extrusion of the polar filament. If there were a polar capsule it should be a matter of no great difficulty to bring about the expulsion of the filament.

Microsporidian spores are, in general, very uniform in size and shape. But in this *Encephalitozoon* parasite the spore-bodies are somewhat different in character in what I have termed the Continental type and the Canadian type. This difference is seen in figs. 3 and 4 respectively.[1] In the former, representing the form of Doerr and Zdansky, Levaditi, Nicolau and Schoen, etc., the spore is narrow, elongate, often slightly bent, and with a deeply-staining granule usually near the centre. The spore as a whole stains the same colour, e.g., red with Twort, blue with Giemsa. On the other hand, there is much less uniformity in the individual spore elements of the Canadian material. These are usually round or oval in shape, though they may at times be slightly elongated. They vary also distinctly in size (*vide* Da Fano's figures), and I have found that some of these isolated

[1] Fig. 3 is from the brain of an apparently normal stock rabbit at the Lister Institute; fig. 4, from material kindly given me by Dr. Maitland

forms have a much less sharply defined appearance than others (cf. my fig. 4). In the case of these elements, moreover, there is usually a marked differentiation into a nuclear body and cytoplasm. The former stains differently from the latter, having a ready affinity for basic stains (e.g., hæmatoxylin), whereas the latter tends to stain red with eosin. With Twort stain the nuclear body is bright red, whereas the cytoplasm is generally (though not always) greenish. No such colour distinctions are to be noted in the Continental type of the spores.

Further details in the structure of these elements have been previously mentioned. It may be added that the nuclear body is very frequently definitely ring-like in character. As regards these spores in the Canadian material, it will be agreed, I think, that there is no possibility of a microsporidian spore being concerned. It could be argued that, in this case, only the endogenous multiplicative forms were present; but as no other kind of spores have been seen in sections of brains from many different rabbits, this appears most unlikely, because the outstanding character of a Neosporidian infection is the presence of abundant spores of the propagative type. It is the early phase of endogenous multiplication that is much more difficult to catch. The nature of and relation between these two rather different forms of spore element urgently requires further elucidation.

(2) *Biological Considerations.*—Here, again, we meet with certain difficulties. Sporozoan parasites are, in general, specially adapted, (*a*) to one host, or a few closely related hosts, and (*b*) to a selective organ or tissue.

(*a*) It appears to me very doubtful that one and the same species would be parasitic, for instance, in both rabbits and mice. And even admitting that two different species, respectively, are concerned, there still remains the fact of the successful inoculation of the rabbit-parasite into other animals, e.g., dog and rat (*vide* Levaditi, Nicolau and Schoen [18]). Another very important point to which, apparently, no attention has been paid, is that sporozoan parasites have a well-defined mode of transmission, for example, either inoculative (as in the case of the malarial parasites), or by contaminative infection, via the digestive tract. In the latter case the spore-membrane undergoes dissolution by one or other of the digestive juices and the germ migrates to its particular site of predilection. In the case of Microsporidia the polar filament is thus extruded and is considered to serve the purpose of entangling or attaching the spore to the wall of the alimentary canal, thereby facilitating the pénetration of the amœbula. Now, it cannot be regarded as at all probable that this specialized method of transmission could be successfully replaced by direct inoculation into one or other part of the body. (Strains, or races of trypanosomes are, of course, in quite a different category.)

(*b*) Leaving aside the Hæmosporidia, in which, by virtue of the fact that the blood is their primary habitat, these parasites may be concentrated in

various vascular organs, the Sporozoa usually have a very elective site. Their particular habitat may be the alimentary canal (cf. fig. 17), connective tissue, etc., or an organ, e.g., liver, kidney, gall-bladder, or brain, and so on. But it is extremely rare to find a tissue- or organ-parasite occurring in more than one of these habitats, and especially in such diverse situations as brain, kidney and liver, *when they cannot be found in the blood* (cf. above, p. 409, vol. 44).

(*c*) Lastly, in the case of Microsporidia, at all events, there is invariably a very definite cell-reaction in the immediate neighbourhood of the cysts (cell-proliferation, hypertrophy and subsequent atrophy, with nuclear degeneration). As has been noted, the apparent cysts of *Encephalitozoon* may occur in areas which show not the least sign of cell-reaction around them (cf. also fig. 2).[1] Conversely, focal lesions, to say nothing of areas of perivascular infiltration (cf. fig. 1), are of very common occurrence, in relation with which no parasites can be found.[2] And it is, I think, a rash assumption to say that in such cases—even in a certain proportion of them—the spores, which represent, it must be remembered, the *resistant* phase of the parasite, destined to transmit the infection to another host, have practically all degenerated and disappeared. Personally, I confess I do not think the evidence is at all adequate that any of these lesions are produced by the alleged parasites. It is at least worth bearing in mind that such lesions, and in some cases the parasites, have been observed in relation with the inoculation of what are regarded as "ultra-microscopic" viruses (cf. Bull, Twort and Archer, Cameron and Maitland, etc.).

The points I have considered above present, I think, considerable difficulty in the way of regarding *Encephalitozoon* as a sporozoan parasite. It may possibly prove to be a lowly type of fungus, allied to the Chytridineæ. Or it may turn out to be something quite different. I can only say that, so far, I have not been able to study it adequately and obtain a sufficient number of transitional stages, or make certain desirable experiments, to enable me as yet to advance any firm hypothesis as to its nature.

I will conclude, however, by quoting from a recent paper [12] by Kling, Davide and Lilienquist, upon which, rather strangely, no comment has been made by the recent authors quoted above. These workers adopt a somewhat doubtful attitude as to the identity of the corpuscles described on the one hand by Doerr and Zdansky and themselves, and on the other by Levaditi, Nicolau and Schoen, which is, I think, quite unnecessary. But the important point is that they remark: "As regards the nature of the

[1] It may be noted that Cameron and Maitland's type of the parasite is more often definitely associated with areas of inflammatory reactions and of hæmorrhage, accompanied by marked signs of alteration and degeneration of the cellular elements in such zones, than the Continental type appears to be (cf. also my figs. 4 and 5).

[2] In some material kindly given me by Dr. C. C. Twort, numerous lesions of typical character, both perivascular infiltrations and focal necrotic areas are present, both in the cerebral cortex and corpora quadrigemina; but in the course of examinations of very many sections, I have not found any parasites.

corpuscles" (*Encephalitozoon*) "there is as yet nothing which proves them to be parasites"; and, again, later on, "in studying this question, it must not be forgotten that they may be analogous to the cell-reaction products formed by certain ultra-microscopic viruses (such as Negri-bodies, Guarnieri-bodies and so on)." The authors add that they have already good reasons for advancing this hypothesis.

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EXPLANATION OF FIGURES.

(All the figures are from photomicrographs, which have been kindly taken for me by Mr. Dennis.)

Fig. 1.—Area of perivascular infiltration in a section of a brain from an apparently normal rabbit. The section passes through the region of the corpora quadrigemina. The infiltrating cells are mainly of large mononuclear and epithelioid (neuroglial) type. (Twort's stain; × 300.)

Fig. 2.—Low-power view of a clump of parasites (a so-called cyst) occurring in the same brain as the above. This cluster is present in several serial sections and must certainly contain more than 1,000 parasites. But there is little or no evidence of host-cell reaction around it. (Twort's stain; × 300.)

Fig. 3.—High-power view of another section of the same clump of parasites. Scattered individual elements on the left show well the usual structural details of the "spore." No indications of a cyst-wall are to be observed. The clump appears to be, really, in a sinus or vascular channel, and in two or three of the sections, flattened nuclei are seen at one side. (Giemsa; × 1,000.)

Fig. 4.—(This and the next figure are from a section of Cameron and Maitland's material, from a block kindly given me by Dr. Maitland. The parasites are numerous in relation with an area of inflammatory reaction in one of the cerebral hemispheres, not far from the lateral ventricle.)

In fig. 4, two compact clumps (A and B) are seen, and in B many of the individual elements are distinctly separate. At C is a loose, ill-defined cluster of the parasites in the lumen of a sinus (in which the clump A also appears to be). At D are two solitary, somewhat ill-defined individual parasites of differing size. (Twort's stain; × 1,000.)

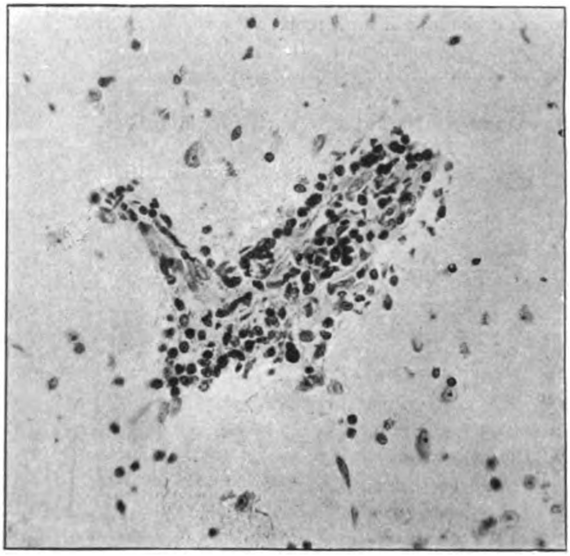
Fig. 5.—Two larger masses of parasites (A and B) in area of plasma cells and epithelioid cells. At the top of the upper mass, which is still more or less in the plasmodial stage, is a border of green-staining cytoplasm, rather tending to indicate that this particular clump is inside a cell. To the left of B is another irregular cluster and a few isolated individual parasites. (Twort's stain; × 1,000.)

Fig. 6.—Cysts of *Rhinosporidium*, in the septum nasi of man, showing different stages in sporulation. Although the magnification of the photograph is low, the spores in the large sporangium (cyst), at the left-hand side, below, are clearly visible. Note the thick cellulose investment to the cyst (*c.m.*). (Hæmatoxylin + eosin; × 100.)

Fig. 7.—Cysts of *Glugea* sp. in the intestinal wall of a plaice, which was literally riddled with them. Note the distinct wall (*c.w.*) to the cysts, which are packed with countless spores. *m*, ruptured mucosa. (Iron-hæmatoxylin + orange; × 66.)

(When the size of the cysts, both of *Rhinosporidium* and of *Glugea*, under such a low power, is compared with that of the so-called cysts of *Encephalitozoon* under a high power, the difference will be realized.)

Fig. 8.—Spores of a Microsporidian (*Pleistophora* sp.) from a flat-fish, for comparison with the *Encephalitozoon* of figs. 3-5. Note especially the refractile appearance of the polar capsule, in the fixed and stained condition. (Thionin; × 1,000.)



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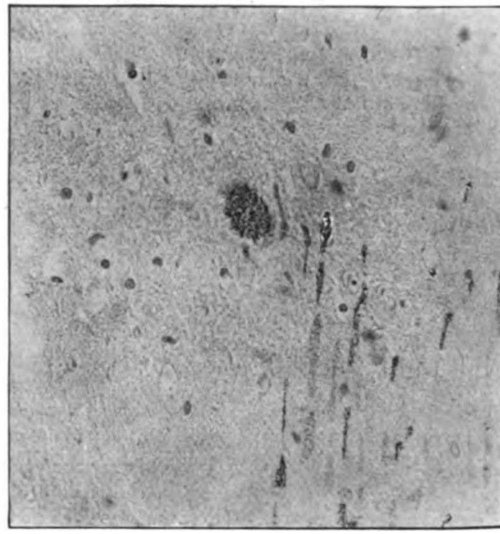

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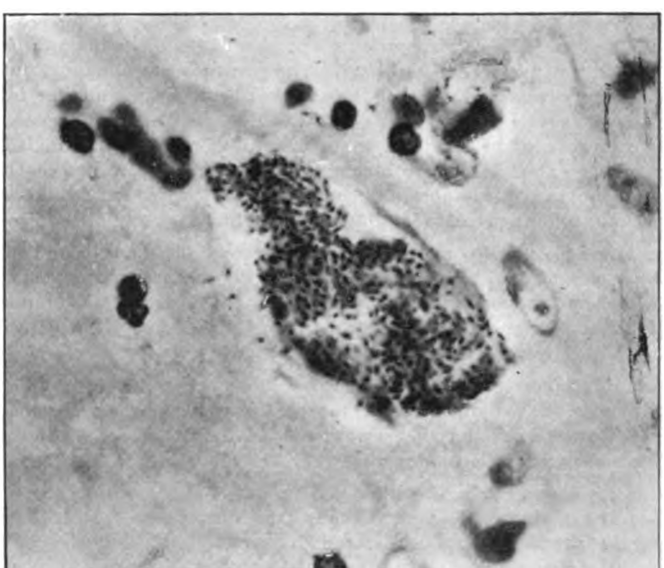

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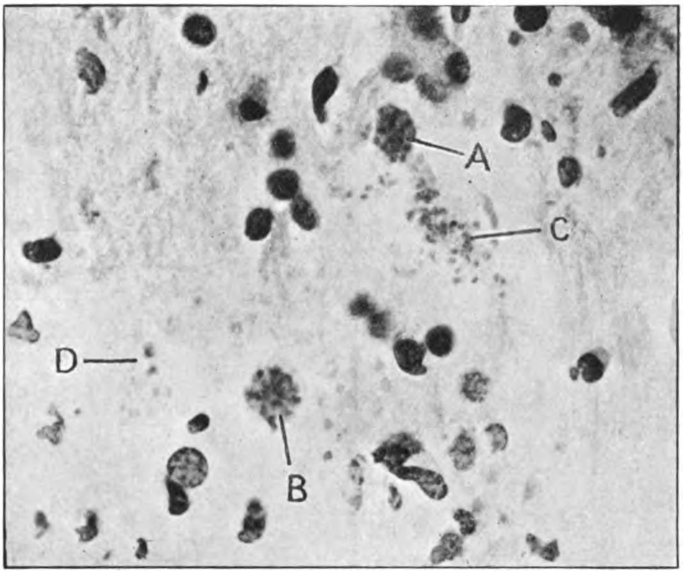

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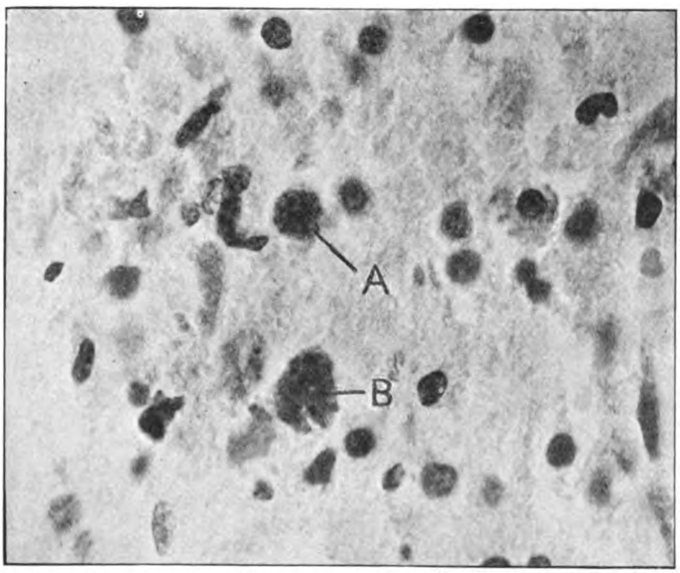

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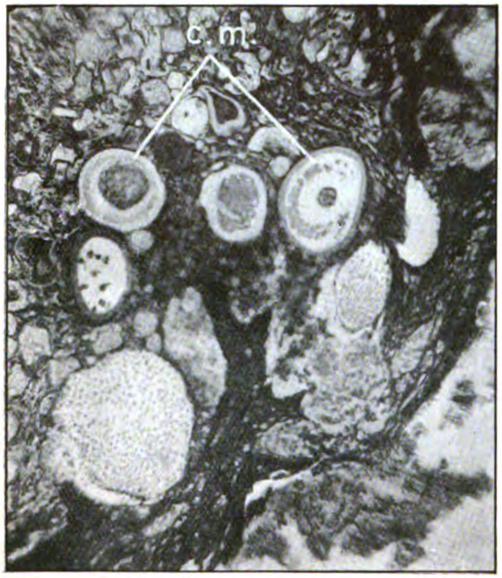

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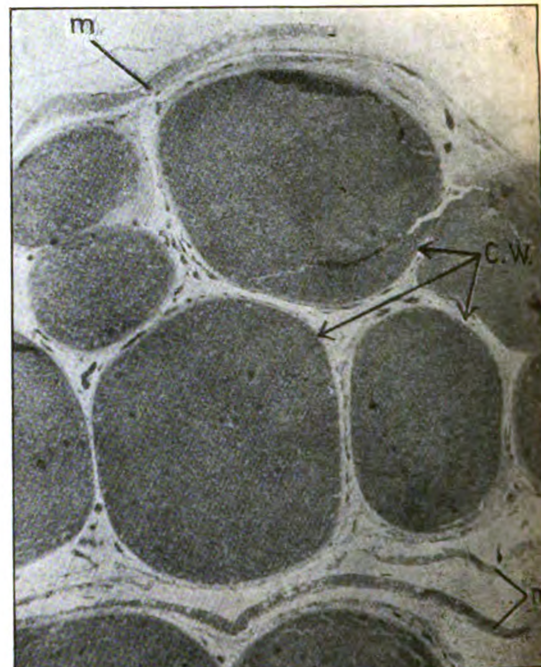

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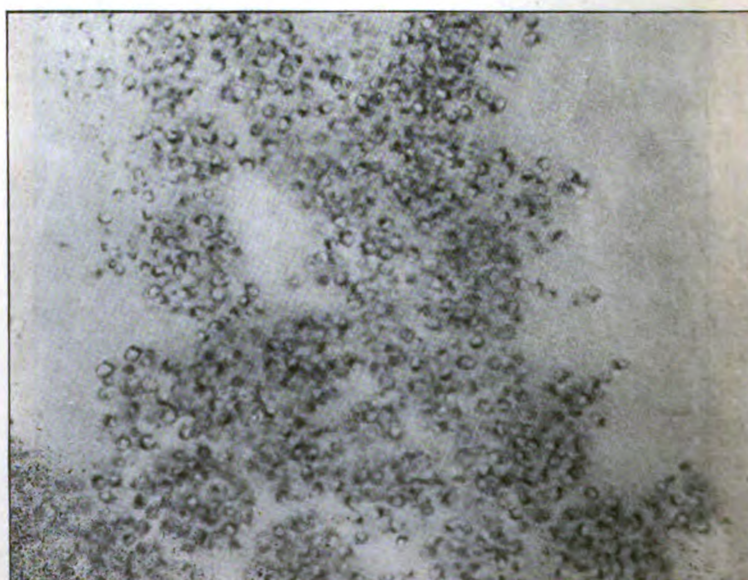


Fig. 8.

RADIOLOGY (In Arduis Fidelis).

By Major D. B. McGRIGOR, O.B.E.
Royal Army Medical Corps.

(*Continued from Vol.* 43, *November*, 1924, *p.* 371.)

V.—Routine Radiography.

In civil hospital practice radio-diagnosis is carried out primarily by the radiologist and secondarily by the consulting staff themselves, who, by the nature of their duties, acquire considerable experience in the interpretation of radiograms. In the Military Medical Services, however, conditions vary considerably, and it is to better these that this article is now written.

The reasons for the inexperience and difficulty in radio-diagnosis in the Service are not far to seek.

The military medical officer is called upon to perform an endless variety of duties. He may be medical officer in charge of a medical inspection room for years, where he will only have an opportunity of viewing radiograms on very rare occasions. He may be engaged in work in special subjects for a long period, where radio-diagnosis does not come his way. Then, as the result of a sudden order, he may find himself working in the wards of a military hospital, or as a member of a medical board, and be called upon to assist in the interpretation of such radiograms as those of cases of pulmonary disease or of the end-results of difficult fracture cases. His difficulty does not end here. He may be shown a first-class radiogram taken in one of our larger hospitals; more often in the case of patients transferred from one small hospital to another or from hospitals abroad, he may suddenly find himself called upon to give opinions based on poor radiograms taken with inferior apparatus under difficult service conditions. Thus it is important for the military medical radiographer to produce all radiograms of the various parts under such regular conditions that those called upon to examine the radiograms, as they are passed on with the case, will have no difficulty in understanding the orientation of the various parts projected on the film. For example, one of the pitfalls for the unwary is the radio-diagnosis of a fracture of the scaphoid, and if the radiographers throughout the Army do not adopt the one special position, some inexperienced reader will be prone to accept the normal overlapping of the shadows of that bone as a fracture. Such overlapping can be avoided by a special positioning of the carpus.

In view of the above, the necessity for routine procedure in the radiography of the common sites becomes obvious, as radio-diagnosis can only be efficiently made if the radiograms to be reported on are known

to be taken in certain ways. Many special examinations, such as localization of foreign bodies, fluoroscopy, radiography of helpless patients, etc., demand quite abnormal procedures and necessitate examinations by an experienced radiologist.

The positions are not called normal positions as this term is a misleading one, each patient has his or her own normal. The following technique is considered particularly suitable in the Service, and if such be universally adopted the work of our various hospitals and their staffs, all working on a common basis for a common cause, will indeed be simplified.

PRELIMINARY PROCEDURE.

(1) *Anatomical Landmarks.*—These have been selected for each position and familiarity with the bony structure, together with the position of the various organs in the body, is essential.

The radiogram shows the bony structure and the various radiopaque organs only in as far as their shadows are projected on to the sensitive film by the beam of "actinic light" (i.e., the X-rays) proceeding from the focal point of the target of the X-ray tube. For correct interpretation of radiograms therefore, it is essential to have some routine standard relations between the source of the rays, the part to be radiographed and the sensitive film.

(2) *Relative Radioparency.*—The routine radiogram should show the best combination of the shadows of the hard and soft structures, and this should invariably be produced unless special instructions are issued for hard or soft structure detail only.

(3) *Overhead Technique.*—This is used throughout. Undertable tube work should never be used in the Service except for special cases. Its use for routine work is an admission on the part of the operator of his failure to grasp the simple factors of alignment of the tube, the part and the film.

(4) *Distance.*—All the ordinary sites can be radiographed at a routine distance of say twenty-four inches or sixty centimetres, unless in special cases other distances are desirable.

(5) *Size of Film.*—The size of the film to be used is not given except in a few cases. A film large enough to take in the required parts properly projected must be used.

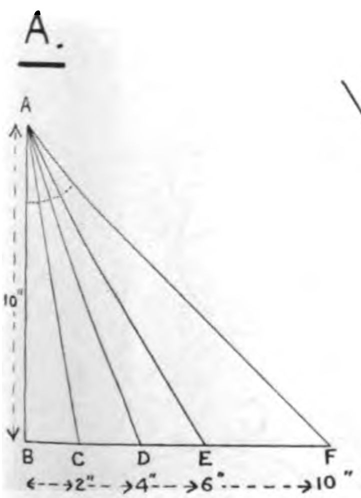
(6) *Position of Film.*—The sensitive film is laid on the table with the correct side of the wrapper uppermost, the part to be radiographed is then laid on the film. The tube is centred over the anatomical landmark or point, hereafter described as the "central ray point," of the area concerned. The central ray point should coincide as nearly as possible with the central point of the film, and the film should as a general rule be at right angles to the line of the central ray.

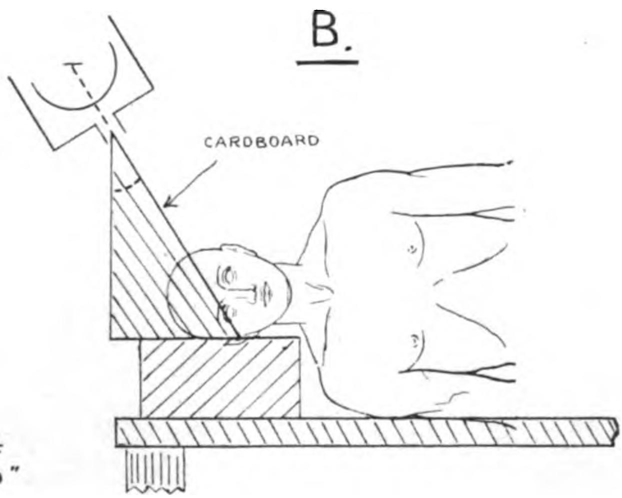
(7) *Number of Films.*—In radiography of all parts of the osseous system at least two films in different diameters or stereoscopic radiograms must be taken, whether asked for on A.F.W. 3172 or not.

(8) *Line of Central Ray.*—The central ray is an imaginary line drawn from the target through the centre of the tube box diaphragm and continued onward to strike the middle point of the film. The line of the central ray can be ascertained either by a simple mechanical device fitted to the diaphragm of the tube box as in diagram L, by a small weight on a thread, or last and not least by the use of imagination and common sense. The central ray should be perpendicular to the film unless otherwise stated. If any deviation from this routine procedure occurs, the fact should be noted in white ink on the face of the negative, so that all into whose hands the negative comes will have no difficulty in its interpretation.

(9) *Angulation of Tube Box or Patient.*—The measurement of the common angles used can be worked out roughly as follows:—

— DIAGRAMS —



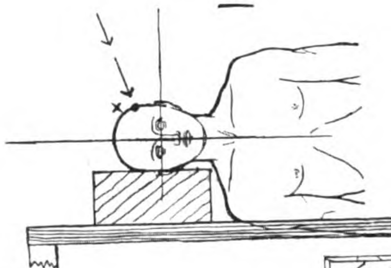


Draw a line A-B 10 inches long.
Draw a line from B at right angles to A-B.
Mark off points C, D, E, and F, at 2, 4, 6, and 10 inches from B respectively.
Join A-C, A-D, A-E, A-F.
The angle B-A-C is approximately 10 degrees.
" B-A-D " 22 "
" B-A-E " 30 "
" B-A-F " 45 "
It is useful to cut four pieces of cardboard to these angles (Diagram A) and use them as in Diagram B.

(10) *Markers.*—The film should always be clearly marked by means of lead markers before the exposure is made, e.g., R for right, L for left, T for top, and if obtainable the serial number of the film should be placed on it with small neat numerals. The importance of marking a film "top" is particularly seen in the case of radiograms of short lengths of the femur

— DIAGRAMS —

C.



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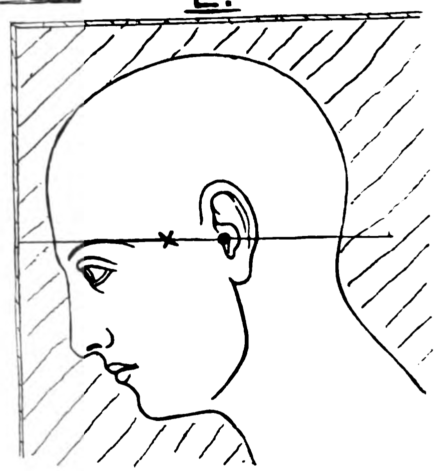

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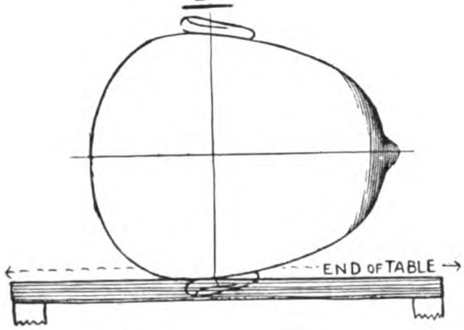

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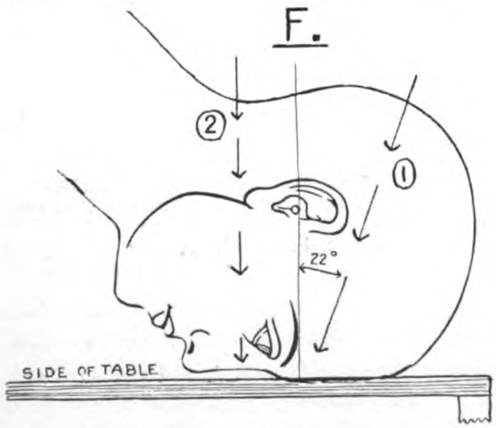

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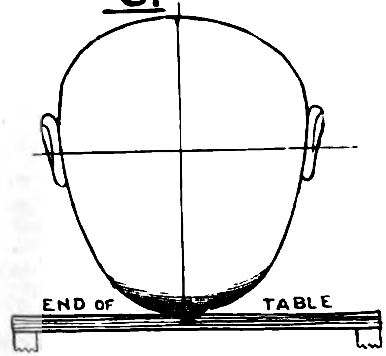
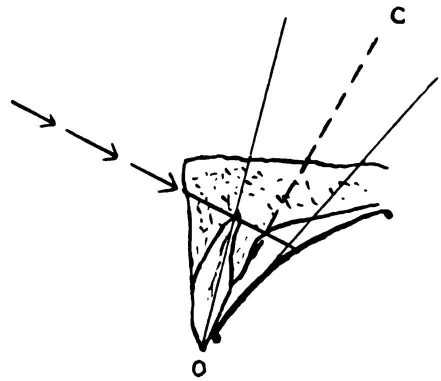


or tibia, etc., and for a novice in the case of lateral views of the spinal column. In naming the positions P.A. or A.P., etc., the surface nearer the film is named last.

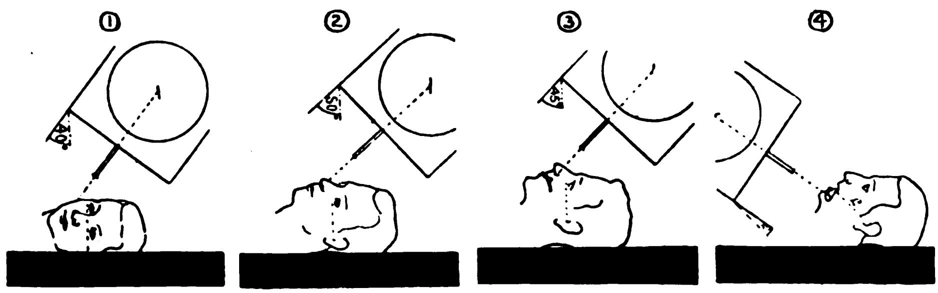
(11) *Hardness of Tube.*—The suitable hardness of tubes to be used is indicated below as the difficulties of this factor are not always appreciated by those whose work only brings them into contact with radiograms on odd occasions.

-DIAGRAMS-

H.



K.



The hardness of a gas tube (as shown by its equivalent spark gap) should not be varied much as this is a difficult process to regulate. It is better to keep three gas tubes in use at the required equivalent spark gaps. With the Coolidge tube, however, the E.S.G. is easily controlled and should invariably be regulated to suit the part. Tubes of an E.S.G. of 4, 5 and 6 inches will suit all routine work.

For hands, wrists, elbows, shoulders, feet, ankles, knees, kidneys, gall-bladder, teeth, lungs, etc., E.S.G. of four inches. For bony chest, cervical, dorsal and lumbar spine, pelvis and hips, E.S.G. of five inches. For head, P.A. and lateral, and opaque meals, E.S.G. of six inches.

(12) *Exposure.*—The exposure is indicated under all conditions by using the Eastman X-ray Exposure Rule, which is now issued to each radiological department in the Army. In cases where a Potter Bucky diaphragm is used, the exposures indicated must in all cases be doubled.

(13) *Photographic Technique.*—As described in JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, Vol. 43, August and November, 1924, pages 114 to 119, and 366 to 371.

(14) *Immobilization of Patient and Tube.*—Sandbags of various shapes

L.

and sizes should be at hand for the purpose of supporting the part to be radiographed in the required position and keeping the part fixed in that position.

The *tube* must be quite steady before the exposure is made.

(15) *Comfort of Patient.*—The patient should always be made as comfortable as the required position will allow. This will tend to eliminate the danger of the part being moved during exposure.

(16) *Cessation of Respiration.*—This in suitable cases means that the patient takes a deep breath and holds it. The current should not be turned on and the exposure made until at least two seconds have elapsed since the patient has been told to hold his breath.

(17) *Protection.*—See "Regulations for the Medical Services of the

Army," appendix No. 16, p. 195, and "X-ray and Radium Protection Committee's Revised Report," December, 1923, reprinted in JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, Vol. 42, May, 1924, p. 389 to 395.

(18) *Stereoscopic Radiography.*—The positions for stereoscopic work will be found to be the same as for ordinary radiograms with the added technique of the tube shift, which, in the case of limbs, should always be at right angles to the long axis of the limb.

(19) *Preparation of Patient.*—A note is added to the individual positions where preparation for examination is necessary.

(20) *Previous Radio Examination.*—The patient must *always* be asked whether he has been previously examined by means of X-rays.

Re-examination must never be conducted within fourteen days unless the urgency of the case is greater than the possibility of the patient's having had a full skin exposure.

* * * * *

What now follows is the enumeration of short definite instructions in the simplest possible manner, and they must be carried out with absolute precision and attention to detail in order to secure uniformity and reduplication. They correspond to what is now taught to the military medical radiographers and should be fully studied also by all those whose work includes the interpretation of radiograms.

Any departure from this practice will result in difficulty, and distortion and deceptive displacements where they do not exist or vice versa.

The credit for good radiograms rests *not* with the apparatus, but always with the individual making the exposure, and even if he has the misfortune to produce a poor negative it is better to produce a poor radiogram taken in a routine position than a good radiogram taken anyhow.

UPPER EXTREMITY.

(1) *Hand.*		
(*a*) P.A.	Position of patient	Palm on film—fingers extended and together
	Central ray	Vertically through head of the third (middle) metacarpal
(*b*) Lateral (semi-oblique)	Position of patient	Place a roller-bandage in the palm and close fingers round it. Rest the ulnar side of the hand on the film. Rotate the hand slightly inward. This will separate the edges of the superimposed bones and show all the metacarpals and phalanges. For individual fingers extend the one required and place film between it and finger underneath
	Central ray	Vertically through head of the third (middle) metacarpal
(2) *Wrist.*		
(*a*) P.A. ..	Position of patient	Palm on film, forearm flat on table, hand in ulnar deviation, thumb abducted
	Central ray	Vertically through a point midway between styloid processes of radius and ulna
(*b*) Lateral ..	Position of patient	Ulnar side of forearm resting on table. For semilunar, plane of palm vertical; for trapezium and scaphoid, slight pronation
	Central ray	Vertically through styloid process of radius

(Always do the lateral view first, especially in children, as it is less painful)
Elbow bent to as near a right angle as possible. internal condyle on film, hand prone with palm flat on table
Vertically through a point ½ inch below external condyle and ½ inch towards head of radius
Forearm supinated, elbow as fully extended as possible, point of olecranon on film
Vertically through a point 2 inches external and ½ inch below internal condyle of humerus. (This will pass through the radio-capitellar joint)

Patient lying on back, opposite shoulder raised slightly on pillow to bring back of required shoulder directly in contact with film, arm slightly abducted, forearm flexed, palm resting on abdomen
Vertically through depression between deltoid and pectoralis muscles just below outer end of clavicle
N.B.—(1) As a general rule stereoscopic radiograms of this position should be taken. (2) Exposure during suspended respiration essential

Patient lying prone, face turned away from exposed shoulder, hands and arms to the sides with palms uppermost
Vertically through prominence formed by middle of spine of scapula
N.B.—As a general rule stereoscopic radiograms should be taken during suspended respiration.

VER EXTREMITY.

Patient sitting or lying with knee up and foot forward, sole resting flat on film
Vertically through distal end of 3rd metatarsal
As in 6 (*a*)

Tube box tilted 22° towards heel of foot and central ray through middle of dorsum of foot over external part of scaphoid
As in 6 (*a*), but with knee inverted as far as possible with the sole remaining flat on film
Tube box tilted 30° towards inner side of foot, central ray to pass through cuboid
Outer side of foot on film

Vertically through a point 2 inches below and 2 inches forwards from internal malleolus

Patient sitting or lying on back, heel resting on film, toes straight upwards (big toes tied together)
Vertically through mid-point of line joining *most prominent parts* on the two malleoli
As for 6 (*d*)

Vertically through most prominent part of internal malleolus

Patient lying prone, toes over lower end of table, centre of patella on middle of film
Vertically through the middle line of the limb at the level of the femoro-tibial joint space, which may be felt laterally

(*b*) Lateral ..	Position of patient	External side of knee on film, joint slightly flexed, ankle raised on sandbag a few inches, knee to be examined in front of the other knee on the table
	Central ray	Vertically through the middle of the femoro-tibial joint space
(9) *Hip.*		
A.P.	Position of patient	Patient lying on back, shoulders slightly raised, big toes tied together, film under buttock
	Central ray	Vertically through mid-point of Poupart's ligament
		N.B.—Stereoscopic radiograms should be taken of this part.
(10) *Pelvis and sacrum.*		
A.P.	Preparation of patient	Patient should have a good vegetable purge the night prior to examination, and come for examination after the bowels have acted freely—NO ENEMA (a badly-given enema is worse than none). On the morning of examination patient should only have an early cup of tea and no breakfast until the examination has been completed
	Position of patient	Patient lying on back, shoulders raised slightly, big toes tied together, film 15 × 12 under sacrum with upper edge 1 inch above the highest points of the iliac crests
	Central ray	Vertically through mid point of line joining anterior superior iliac spines
(11) *Long bones.*		
Radius and ulna, humerus, tibia and fibula, femur	Position of patient	When the shafts of these bones are radiographed, the surgeon or radiologist will require two views taken exactly at right angles. This can best be done with the patient lying on back and the bone in question near the appropriate edge of the table or bed
		Place one film under the limb
	Central ray	Expose with central ray perpendicular to film
	Position of patient	Without moving the limb place another film at right angles to the first on the inner side of the limb.
	Central ray	Adjust the tube to the new position again with the central ray perpendicular to the film.
		N.B.—It is better to provide *any* two views exactly at right angles to one another than to have an exact A.P. view and untrue lateral.

TRUNK.

(12) *Cervical spine.*		
(*a*) Upper C. 1, 2, 3. A.P.	Position of patient	Patient lying flat on back, occiput resting on table, mouth wide open with cork between teeth, film under occiput and neck
	Central ray	Vertically through mouth
(*b*) Lower C. 3, 4, 5, 6, 7. A.P.	Position of patient	Patient lying flat on back, occiput on table, chin slightly raised, film under neck
	Central ray	Vertically through "pomum Adami"
(*c*) Lateral	Position of patient	Patient on side, head raised on support to keep cervical spine straight like the head in diagram C, chin slightly extended, both shoulders as depressed as possible, the under arm must be behind the patient as this position gives maximum depression of the shoulder; press film into supra-clavicular space
	Central ray	Vertically through a point one inch behind and one inch below angle of jaw
(13) *Dorsal spine and ribs.*		Radiograms of the dorsal spine must be made during suspended respiration
(*a*) Upper D. 1-10. A.P.	Position of patient	Patient lying flat on back
	Central ray	Vertical through mid-line of sternum at level of 3rd costal cartilage. This will pass through the disc between D. 6 and D. 7

(*b*) Lower D. 11 and 12. Upper L. 1 and 2. A.P.	Position of patient	As for 13 (*a*)
	Central ray	Tube box tilted 10° towards feet and central ray through the epigastric notch
(*c*) Semilateral		The semilateral view is here advised as the most practical radiogram of this part of the spine. It is almost impossible to obtain a true lateral view with apparatus of moderate power
	Position of patient	Patient lying on left shoulder-blade, turned half left at angle of 45° on the table
	Central ray	Vertically through right nipple.
(14) *Lumbar spine.*		
(*a*) Lower L. 2-5. A.P.	Preparation of patient	As for 10
	Position of patient	Patient lying on back, shoulders raised slightly, knees flexed and supported
	Central ray	Vertically through a point 1 inch above the umbilicus
(*b*) Lateral ..	Position of patent	Patient on side with knees well up, arms above head, film under side
	Central ray	Vertically through side $1\frac{1}{2}$ inches above highest point of iliac crest

CHEST.

(15) *Chest.* (Radiograms of the chest must be made during suspended respiration.)

(*a*) A.P... ..	Position of patient	As for 13 (*a*)
	Central ray	As for 13 (*a*)
(*b*) P.A. (Usual for lungs and heart)	Position of patient	Patient prone on table, arms by the side, palms uppermost—shoulders thus allowed to sag down on to the table—chin to one side. Film 15 × 12 placed with 1 inch showing above the highest point of shoulder
	Central ray	Vertically through 5th dorsal spine
(*c*) Right lateral oblique. (Usual for aorta, posterior mediastinum, œsophagus)	Position of patient	Patient prone, resting right side of chest on film, both arms by the side (patient thus lying turned half left on the table), anterior wall of chest at 60° to table
	Central ray	Vertically through a point just below the lower angle of left scapula

URINARY TRACT.

(16) *Kidneys and upper ureters.*

(*a*) A.P... ..	Preparation of patient	As for 10
	Position of patient	Patient lying on back, shoulders raised, knees flexed and supported. Film 15 × 12 placed under back—cessation of respiration
	Central ray	Tube box tilted about 10° towards head of patient. Central ray through a point in middle line about 1 inch above umbilicus
(16) (*b*) *Lower ureters and bladder.*		
A.P.	Position of patient	As in 16 (*a*), with legs straight instead of knees flexed
	Central ray	Tube box tilted about 10° towards patient's feet, central ray through a point in middle line 2 inches above symphysis pubis

ABDOMEN.

(17) *Opaque meal.*		
P.A.	Preparation of patient	The patient should lead his or her usual life as regards food and laxatives. The patient must arrive for examination in a condition neither more constipated nor more purged than usual. Any medicine containing bismuth or any other radiopaque salt should be avoided for three days prior to examination.

		On the morning of the examination the patient is only allowed an early cup of tea and slice of toast. No breakfast and no food until permission is given by the examining officer. (This is usually until the stomach is certified free from the Barium Meal)
	Position of patient	Patient lying prone on table. Cessation of respiration.
	Central ray	Vertically through (*a*). For stomach, 2nd lumbar spine (*b*). For intestines and colon, 4th lumbar spine. N.B.—In any extended series of examinations such as opaque meal, it is advisable to use a 2-mm. aluminium filter to minimize possibility of skin damage

Gall-Bladder.

(18) *Gall-bladder.*

P.A.	Preparation of patient	As for 10
	Position of patient	Patient lying prone, hands above head, chest slightly raised and bent towards left side (not rotated). Centre of film under right hypochondriac region at 9th costal cartilage
	Central ray	Tube box tilted about 45° towards head of patient, central ray through a point 2 inches to right of second lumbar spine. N.B.—Always do three radiograms of the gall-bladder area in this position, with tubes of equivalent spark gaps of 4, 5 and 6 inches respectively

Head.

(N.B.—Always remove false teeth, hairpins, etc., before radiographing head or teeth.)

(19) *Skull.*

(*a*) P.A.	Position of patient	Nose and forehead on film, head exactly square, as in diagrams F and G
	Central ray	Vertically in middle line of skull to meet film at supra-orbital ridge
(*b*) Lateral ..	Position of patient	Head on side on the film supported with the central sagittal plane through mid-forehead, nose and chin parallel with the film and the line joining the eyes vertical as in diagram C. Diagram D shows the view of the patient's head from the head end of the table. Diagram E shows the head as viewed from the target, the line joining the supra-orbital margin and external auditory meatus at right angles to the long axis of the table.
	Central ray	Vertically through a point on the line joining supra-orbital margin and external auditory meatus 3 cm. in front of the latter and marked X in diagram E

Accessory Sinuses and Sella Turcica.

(20) (*a*) *Sphenoidal sinuses and sella turcica.*

Lateral	Position of patient	As for 19 (*b*)
	Central ray	As for 19 (*b*)
(*b*) *Frontal sinuses* P.A. ..	Position of patient	Forehead on film, head square (see diagrams F and G), with the external auditory meatus vertically above supra-orbital ridge (see diagram F)
	Central ray	Tube box tilted 22° towards patient's feet—central ray through middle line of head to meet film at supra-orbital ridge as in diagram F 1

(c) *Maxillary antrum* P.A.	Position of patient	As for 20 (b)
	Central ray	Vertically in middle line through mid-point of bridge of nose (see diagram F 2)
(d) *Mastoid process and cells* ..	Position of patient	As in 19 (b)
	Central ray	Tube box tilted 30° towards feet of patient, central ray through a point on parietal bone 3 inches above external auditory meatus marked X in diagram C

TEETH.

(21) *Six dental films and two extra-oral half-plate films are used.*

First dental film	..	Upper molars left
Second ,, ,,	..	Upper bicuspids and canine left
Third ,, ,,	..	Upper incisors
Fourth ,, ,,	..	Upper canine and bicuspids right
Fifth ,, ,,	..	Upper molars right
Sixth ,, ,,	..	Lower incisors
First extra-oral film	..	Lower jaw left
Second extra-oral film	..	Lower jaw right

N.B.—Any false teeth must be removed before exposure is made.

Dental Films.—The film must be placed in the mouth so that the edge of the film lies along the biting border of the teeth. In the case of the left upper teeth and upper and lower incisors the film should be held in position by the patient's own right forefinger. In the case of the right upper teeth the patient's left forefinger is used.

The central ray should always pass through the surface position of the apices of the teeth required and perpendicular to the dotted line OC in diagram H. The following positionings of head and tube will give the conditions required. The tube box angle required varies from 40-50° on different jaws.

(a) *Upper jaw.*—Patient lying on back facing roof with infra-orbital margin vertically above external auditory meatus

Incisors ..	Position of patient and central ray	In this position the incisors are taken by passing the central ray as shown in diagram K.3
Bicuspids and canines	Position of patient	Head rotated from above position 45° towards opposite shoulder (always retaining the infra-orbital margin vertically above the external auditory meatus)
	Central ray	Central ray as in diagram K.2
Molars ..	Position of patient	Head rotated as near 90° as possible
	Central ray	Central ray as in diagram K.1
(b) *Lower jaw.*		
Incisors ..	Position of patient	Patient lying on back with head thrown as far back as possible with comfort, head square
	Central ray	As in diagram K.4, in the plane of the point of the chin and the external auditory meatus
Extra oral films.		
(c) *Lower jaw.*		
Canine apices, bicuspids, molars	Position of patient	Patient as prone as possible with comfort, head turned to opposite shoulder, neck to rest across a support angled at 22° to the table as in diagram L, chin extended, cheek on the film
	Central ray	Tube-box tilted 22° towards the head-end of the table. Central ray through a point 1 inch along the lower border of jaw from the angle and ½ inch down

THE ACIDIC VALUE OF THE URINE IN SKIN AND OTHER MANIFESTATIONS.[1]

A Study of Abnormal Hydrogen-ion Concentration as an Indication of Disease.

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Urine with a high acidic value is a very much commoner condition than is generally supposed. Many people have it in a definitely pathological degree who are apparently in perfectly good health. It would appear that this state is an indication of some underlying disease, of the nature of which we know nothing. This obscure condition is a grave menace to our well-being, and sooner or later, on the advent of some additional or superimposed strain, some organ or tissue of the body will refuse to function properly. It prevents or hinders the clearing up and healing of lesions, and there seems to be no doubt that it can, by itself, poison various tissues of the body. I make the suggestion that it is usually congenital but may be acquired. Treatment with alkalies will relieve the patient and allow the lesions to heal up, but the high concentration of the hydrogen-ions in the urine will return and the patient will have a relapse when another strain is put upon the organs or tissues. Thus it would seem that this high acidic value, apart from treatment, is permanent. The only exceptions that I have found so far to this rule are in cases of gastro-intestinal toxæmia. In this type of case there is usually an erythematous or papular rash and the pH value of the urine varies from 5 to 5·6. When the rash fades away, the pH value of the urine returns to normal, even without treatment, showing that the phase is only a temporary one.

Although I have been working on this state for the last twenty-one months, chiefly from the dermatological point of view, I have been struck by the number of patients in the medical wards who have shown a great intensity of the acid in their urine, and by the change for the better that takes place the moment they are treated with large doses of alkalies.

The pH Value of the Urine.

The only method employed throughout my investigations was to find out the pH value of the urine, as I found there was no increase in the actual amount of acid present in the urine of the patients I was testing. In other words, there was no true acidosis. If the pH value was pathological, I

[1] Reprinted by kind permission from the *Lancet*, 1925, vol. ccviii, No. 5293.

endeavoured to bring it to the normal limit and keep it there. This normal limit I have found by examining very large numbers of healthy men to be from 6·4 to 6·8. I was careful to exclude all those with skin diseases, especially seborrhœics. Even then I found a small percentage with a high pH value. It is analogous to those people who without any signs or history of syphilis are found to have a strongly positive Wassermann reaction. Also, as with them, the question arises, should they be treated? Until more is known as regards the causes of the state that question cannot be answered.

The cardinal fact underlying my clinical investigations is that the mean hydrogen-ion concentration of the urine in certain skin and other diseases is of a high order, but that no abnormal increase in titratable acids can be found associated therewith.

The possible causes of this might be: (1) The excretion of an abnormal acid of high dissociation constant. (2) The deficient excretion of one or more of the normal urinary buffers, so that the normal urinary acids cause a marked increase in the hydrogen-ion concentration. (3) The abnormal excretion of some element which causes increased dissociation or hydrolysis of one or other of the urinary constituents which are combinations of a weak base and strong acid and vice versa, or to some other cause.

The fact that quite moderate doses of alkalies are sufficient to change the pH value to normal limits instead of the massive doses required in true acidosis cases to cause the same pH change seems to indicate that there is no real acidosis underlying the condition, but that some equilibrium change or changes cause the normal urinary acids to give a high intensity value.

The pH value of the blood is of no help, but the clue to the urinary changes may possibly be found in the blood chemistry of these cases. In the quantitative blood examinations of the acid and alkali buffers, the alkali reserve, the pH values obtained from determinations of the free and fixed CO_2 ratio, and direct electrometric measurements might be of value in determining the operative factors. The changes in the sweat and saliva promise to be of interest.

Examination of the Urine.

By taking morning and evening specimens I found that the pH value varied within certain limits according to the amount and kind of food taken, and also with the interval of time taken since the last meal. It is better to start with a specimen taken the first thing in morning and the last thing at night, and later examine twelve-hour samples. Occasionally I find it useful to also test a specimen taken two hours after a big meal. The urine should be examined daily until the patient is well under treatment, when once or twice a week will suffice.

The Urine in Patients with Skin Manifestations.—In some 500 cases of patients suffering from skin diseases, I found that all those with seborrhœa, seborrhœic eczema, acne, and cheiropompholyx, without a single exception,

had a urine with a pH value of from 4·8 to 5·8, unless alkalies had been given. Infantile eczema is not a seborrhœic condition, the urine in these cases gives a normal pH value, and the patients do not improve on alkalies.

Dr. H. W. Barber, in an article written in conjunction with Dr. H. C. Semon entitled "Some New Observations on the Ætiology and Treatment of Seborrhœic Eruptions" [1], was the first to point out that the seborrhœic state is really a manifestation of acidosis, and that in the great majority of cases the activity of the inflammatory processes ceases as soon as the urine is rendered virtually alkaline. The article goes on to say that although the chemical examination of the urine has never revealed the presence of di-acetic or β-oxybutyric acids, nor is it suggested that the degree of acidosis present in all resembles that commonly met with in diabetes, it is not to be denied that there are certain resemblances in the clinical features of the two diseases.

In the light of my recent work I am in absolute agreement with these views, except that I consider that the word acidosis is not the correct word to use for this condition, and suggest that "acidic value" is more in accordance with chemical findings.

Dr. Richard L. Sutton, in his book, "Diseases of the Skin" [2], writes as follows:—

"Barber and Semon believe that all patients with status seborrhœicus suffer from relative acidosis, and recommend the adoption of appropriate treatment, but Sweitzer and Michelson [3], in an exhaustive and careful series of studies, were unable to establish any ætiologic relationship between the two conditions. Inquiry among pediatricians disclosed the fact that in a large number of cases of acidosis observed, due to a variety of causes, no cases of infantile eczema or of seborrhœic dermatitis were encountered."

These investigators must have fixed their attention on the amount of titratable acids and ignored the hydrogen-ion concentration altogether, otherwise they could not have failed to have been struck with the extraordinary high acidic value of the urine of all the seborrhœics they examined.

The Action of Alkalies on Patients with Skin Manifestations.

Seborrhœic Eczema.—The action of alkalies on patients with this condition is very marked, even on those cases who have had eruptions for years. The weeping stops, the angry look dies away, the redness becomes paler and paler, the irritation ceases, a thin bluish-coloured skin covers up the lesion, and then normal skin appears and the lesion is healed. This can occur without any local treatment of any kind having been applied. The length of time taken to effect a cure depends on how long it takes to bring the urine to a normal pH value, and this naturally varies with each case. If too much alkali is given and the pH value of the urine reaches from 7·2 to 8, the lesions tend to reappear, and unless the dose is cut down or stopped the patient's condition may become worse. This rather rare result of over-treatment is well illustrated in the following case:—

Case 1.—J. P., a man, aged 36, who had had no previous skin trouble. He was badly wounded in 1916 and was given an injection of anti-tetanic serum and sent to hospital in England. Here he was given a second injection which, he states, caused him to break out in a rash all over his body, which remained long after his wound had healed ; in fact, he was in hospital for eighteen months. In time his skin became normal except for a weeping dermatitis covering both his hands. He had received treatment from several eminent dermatologists without the lesions clearing up. He was forced to wear gloves continually, and consequently was too shy to dine away from home. He was very anxious, on his first visit to me, to attend a big dinner in Paris forty-eight hours later. I gave him half a pound of bicarbonate of soda with instructions to take a teaspoonful three or four times a day. His hands were perfectly healed by the time he arrived in Paris. Against my advice he continued taking large doses of this salt and in a few days, after consuming some pounds, he developed a weeping dermatitis covering practically the whole of his body. The pH value of his urine was then 8. On stopping the medicine the rash cleared up, taking ten days to do so.

The next case shows the action of alkalies both on the skin condition and on the kidneys.

Case 2.—J. J. R., a man, aged 49, had had seborrhœic eczema for ten years, chiefly limited to the face and neck. The skin was red, swollen, and weeping. He stated that it started as a small itching spot on his nose which he scratched. He must have infected this with his nails, for the spot rapidly spread, and in a few weeks his whole face and neck was a mass of weeping and irritating eczema. Every form of local treatment was tried for years, but with only slight relief. He spent several hours a day either bathing his face with lotion or smearing ointment on it. He was unable to go into a heated room or to drive in an open car. At times it was impossible for him to shave, and he never was able to lather or wash his face with soap.

When first seen in April, 1923, the report on his urine was as follows: Sp. gr. 1010, very acid to litmus, H-ion concentration pH 5·8, trace of albumin present, but no nucleoprotein, acetone, aceto-acetic acid, phosphates (earthy), urates, bile salts, or sugar. Quantitative albumin (Esbach) was under 0·01 per cent. Centrifugalized deposit: Microscopical examination showed a few granular casts, a few tubular renal epithelial cells, and a few leucocytes, but no red blood corpuscles or crystals, etc.

Under drachm doses of sod. bicarb. his condition rapidly improved, and I was able to reduce the amount by half in a few weeks. He carried on the same local treatment that he had done for years. Not only did the eczema clear up, but his kidney condition, as shown by the examination of his urine, became normal. I noticed that if his urine stayed between 6·4 and 6·8 his face remained in a perfectly normal condition. If it went to 5·9, his skin started to inflame, and casts, renal cells, and leucocytes

reappeared in his urine. If it went to the alkaline side of 7 his face condition remained good, but the casts, etc., reappeared. Thus the pathological report on his urine on November 8 was as follows: Sp. gr. 1014, very alkaline to litmus, H-ion concentration pH 7·6, albumin present and a trace of nucleoprotein.

The amount of albumin present was more than that found in all recent specimens, but was too small in amount for quantitative estimation. There was a trace of indican, but chemical tests showed the absence of blood and pus. There was no acetone, aceto-acetic acid, bile salts, or sugar, and no urates, but earthy phosphates were abundant. Centrifugalized deposit: Microscopical examination showed granular hyaline casts and a few renal cells, leucocytes, but no erythrocytes. Triple and stellar phosphates were present. The increased albumin, casts, etc., may possibly be due to the abnormally great alkalinity of the urine.

From December, 1923, to the present time he has a slight relapse of his skin condition when his urine is very acid, but his renal state remained very good, even when his urine reached 5·6 or 7·6. So it appears that the treatment has allowed his kidneys the chance of recovering. Thus, on May 30th, 1924, the report on his urine was as follows: Sp. gr. 1016, alkaline to litmus, H-ion concentration, pH 7·6. There was no albumin, nucleoprotein, blood (chemical), indican, acetone, aceto-acetic acid, urates, bile salts, or sugar, but earthy phosphates were very abundant. Centrifugalized deposit: Microscopical examination: No casts, renal cells, leucocytes, or other organized cells were present, but a few stellar phosphates, triple phosphate crystals, and a very large amount of amorphous phosphates. He is still taking bicarbonate of soda in half-drachm doses two or three times a day. He is leading a perfectly normal life, and except for meat he eats anything he likes.

Case 3.—L. S., a nursing sister, had an outbreak of seborrhœic eczema in Malta three years previously. When I first saw her fifteen months ago she had a very acute, weeping, and irritating dermatitis, involving chiefly her arms and legs. It took a pound and a half of cotton wool a day to absorb the fluid from the lesions. I ordered her to bed and put her on medium doses of bicarbonate of soda and potassium citrate. I gave her no local treatment whatever. She begged to be allowed to apply one of the many lotions she had been in the habit of using and complained bitterly when this was refused. In two days the lesions were healing and had quite cleared up at the end of ten days. Since then I hear she has had a slight relapse when she had an attack of influenza some months later, but on continuing the medicine, which she called "the magic draught," it completely healed up.

The cases described above illustrate very well the action of alkalies on seborrhœic eczema; they are only three out of over one hundred examples I could quote. Rarely one meets cases that do not clear up quite easily under alkalies, even with the help of local treatment. These cases are due

to a skin sensitization to a staphylococcus, fresh lesions breaking every now and then at a distance from the original focus. This staphylococcus is usually *S. aureus*, sometimes *S. albus* or even *S. citreus*. These cases require to be desensitized by injections of autogenous vaccines, peptone injections, low carbohydrate dietary and other means. These have been described by Dr. Barber. Cheiropompholyx I place in the same category as the above, the action of alkalies is just as remarkable, and no local treatment is usually required.

Seborrhœa.—The action of alkalies on seborrhœa, wherever it is situated and whatever the type may be, is a very great aid to, but can never replace, local treatment.

Acne.—Here, again, local treatment must be energetically carried out. One case will serve to describe the change that takes place when alkalies are administered.

J. M., a girl, aged 17, had been treated for acne since she was 11. For the past three and a quarter years she had been under the direct care of a distinguished dermatologist. Every form of modern treatment had been tried in her case, including the administration of an autogenous vaccine and radiotheraphy. When first seen by me her face and back were covered with typical acne. The pH value of the morning urine was 5, and the evening specimen 5·1. Three days after the administration of alkalies, when the pH value had been raised to 5·3, she started to improve. At the end of a week the change was very marked. What especially impressed her mother at this time was that the scalp and skin were no longer greasy and no fresh "spots" had appeared. At the end of a fortnight she was well on the way to recovery. I noticed that the deep-seated pustules had worked their way to the surface. In four weeks she was clear of active signs, and all that remained were a few healing scars and some small comedones.

Other Skin Conditions.—Amongst other skin conditions that have an abnormally high pH value and that greatly improve or are cured by administering alkalies are prickly heat, carbuncles, abscesses, boils, and a generalized prurigo. This latter condition is often seen in cases that have, to all intents and purposes, a normal-looking skin. I find in these cases that before the itching is relieved the pH value of the urine has to be pushed up to 7·5 or 8.

The Urine and the Action of Alkalies in Other Diseases.

It is with diffidence that I write on the high pH value of the urine in other diseases than those of the skin, and it is really to suggest the lines that research workers might follow that I state my limited experiences. In gout and rheumatism the pH value is high and alkalies give marked relief. Neurologists might test out the acidic value in their cases. Epilepsy, neurasthenia, and hysteria are examples of diseases in which I have found a high percentage of abnormal acidic urines. It would be of great interest if independent observers would record their researches in the large group of psychic and other ailments of the central nervous system, many of them

involving a derangement of the autonomic system, vago- and sympathicotonic, and which in many cases exhibit cutaneous manifestations. It would seem worth while if the pH value of the urine of all patients admitted to hospital was ascertained, as alkalies are of such remarkable value in diseases as far apart as blackwater fever and broncho-pneumonia. It may account for the benefit some people derive from taking proprietary salts, and attendance at alkaline spas.

I have recently examined the urine in the cases that have shown a marked reaction to vaccination, injections of T.A.B. vaccine and serums. They all show a pH value of from 5 to 5·6, even when they were well again. If alkalies are given to cases that have a high hydrogen-ion concentration to their urine, I find that when their urine is approaching the normal limit the patient generally volunteers the statement that any symptom of stiffness after exercise, headache or heavy feeling, previously complained of, has gone, and that he wakes up fresh in the morning, and getting up is no longer any trouble to him. Chronic dyspepsia is greatly relieved or has absolutely disappeared, also, in some instances, certain articles of diet which before caused inconvenience or even rashes or other toxic symptoms, can now be eaten with no bad after-effects. Strawberries and bananas are two instances.

Treatment with Alkalies.

In each case it is necessary to experiment before the exact dose can be gauged. Dr. Barber and Dr. Semon, in the article quoted above [1], state how difficult it often is to bring the urine to the normal limit. Here my experience in the treatment of gonorrhœa was useful, especially that gained when I was experimenting with acriflavine, which has to be given with the patient's urine alkaline. The mixture which I now always start with, and which I call mist. acidosis (for want of a better name), is a modification of Dr. Langdon Brown's mixture for the treatment of the acidosis in diabetes. It consists of :—

℞	Sod. bicarb.	..	..	gr. 30
	Pot. bicarb.	..	..	gr. 25
	Pot. cit.	..	..	gr. 20
	Tinct. card. co.	..	..	min. 30
	Aquam menth. pip.	..	..	ad oz. 1

This is given three times a day, between meals, increasing or decreasing the dose according to the pH value of the urine.

My best thanks are due to Dr. Barber for his advice and help, to Dr. Lyn Dimond for his interest in my work and for his skill in carrying out the pathological side of the investigations, and also to Major R. E. Todd, M.B., R.A.M.C., for many useful suggestions and his help and encouragement.

References.

[1] Barber and Semon. Journal of the Royal Army Medical Corps, 1919, xxxiii, 244.
[2] Sutton, Richard L. "Diseases of the Skin," fourth edition, London: Henry Kimpton, 1921, p. 910.
[3] Sweitzer and Michelson. *Arch. f. Dermat. and Syph.*, Chicago, 1920, ii, 61.

OBSERVATIONS ON THE GROWTH OF MENINGOCOCCI *IN VITRO* IN RELATION TO VIRULENCE.[1]

A REPORT TO THE MEDICAL RESEARCH COUNCIL ON WORK CARRIED OUT AT THE UNIVERSITY OF CAMBRIDGE PATHOLOGICAL LABORATORY AND FIELD LABORATORIES.

BY E. G. D. MURRAY AND R. AYRTON.

(*Continued from page* 444, *Vol. XLIV.*)

VI.—THE RELATION OF MEDIUM TO VIABILITY AND MAINTENANCE OF VIRULENCE.

IN the foregoing sections we have discussed the influence of the constitution of the medium upon physiological characters of the meningococcus which can be measured in terms of reproduction *in vitro* and adaptation to a parasitic existence. In the present section we wish to consider briefly a few scattered observations on the duration of the life and the virulence of cultures of that organism *in vitro*.

It is generally agreed that the life of a culture of meningococcus on the ordinarily used media is short, and it is very commonly stated that the culture may die within forty-eight hours. Various media have been considered satisfactory because stock cultures remained alive for one or two months, and it is quite likely that the strains used had been subjected to subculture before the test was performed. In our experience, before we had investigated the facts detailed in the preceding sections, Dorsett's egg medium maintained the life of meningococcal cultures better than the other media we had tried. A large proportion of cultures on egg could be recovered when they were a year old and only an occasional one died in less than six months, but absolute certainty only prevailed with monthly subculture. In any case direct subculture from an egg slope a month or more old on to agar media was often a matter of difficulty, it frequently failed to give any growth and quite commonly only a few scattered colonies resulted, even with quite heavy inoculation. Subculture from egg to egg gave better results, but, even so, the appearance of only a few scattered colonies was a far too frequent occurrence; and these scattered colonies commonly had to be subcultured daily for a few generations before vigorous growth obtained. Thus it became our usual practice, when growth of a particular strain living on egg was required on agar medium, to resort to an intermediate young subculture on egg.

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[1] Reprinted from the *Journal of Hygiene*, vol. xxiii, No. 1, October 15, 1924, by kind permission.

When we first observed the difference in virulence of cultures grown on particular samples of *EDB/N* and *EDB/S* media, we were examining the influence of repeated subculture on the growth of the meningococcus. Two series of subcultures were being run at the same time: one at twelve and the other at twenty-four-hourly intervals. In the twenty-four-hourly series there was a marked initial lag with each subculture, but in the twelve-hourly series growth appeared more and more rapidly with successive subculture, until, after a few generations, four hours' incubation yielded a considerable growth. In the course of thirty-six days the *EDB/N* medium with which we had started came to an end and we proceeded with a batch of *EDB/S*; these were the same batches of media on which we had noticed the difference in virulence, but we did not at first observe any marked difference in the growth as these generations were carried out on slopes, in test-tubes plugged with wool in the ordinary way. We had previous y noticed that cultures which were kept at 37° C. for fourteen to thirty days occasionally gave rise to scattered colonies superimposed on the old growth, so these various cultures were all kept for a month to watch for this secondary growth, without any precautions to prevent drying of the medium. Out of the 108 cultures grown on *EDB/N* (No. 86) (71 from the 12-hour and 37 from the 24-hour series) only 4 showed secondary growth; whereas of 37 cultures grown on *EDB/S* (No. 88) (25 of the 12-hour and 12 of the 24-hour series) every one gave good secondary growth.

In view of the experiments described in Section V, the outstanding feature of this observation depends upon the fact that growth yielded by *EDB/S*, No. 88, was virulent, whereas the same strain grown on *EDB/N*, No. 86, failed to kill mice. Backed by our observation on virulence in relation to these media, secondary growth immediately became a character of importance in our eyes, and caused us to think of the possibility of making a medium which would maintain a culture alive for a considerable time without loss of virulence.

At the time we thought these important differences might be due to the digest having been contaminated or not during its preparation and we resolved to test the viability of cultures on *EDB/N* and *EDB/S* media, with the result that in this case the non-sterile proved to be the better, but still fell far short of egg for this purpose, as is shown in Table IX.

TABLE IX.

Medium kept at 37° C. with waxed plugs	Subcultured from	Number of cultures	Number shown to be alive 9 months later, by subculture on *EHD/V* medium
EDB/N No. 72	Bacteriolysis Expt. 50, XVII	24	14
EDB/S No. 138	Bacteriolysis Expt. 50, XVII	26	7
Egg	*EDB/N* 72	18	18
Egg	*EDB/S* 138	16	15

Media 72 and 138 showed an identical increment in the "Sörensen figure" due to added digest; but there is considerable evidence that the

concentration of digest 122 used for making No. 138 and other media was not favourable for virulence, and some evidence that No. 72 was a better medium from this point of view. No very precise information on this point is available because we had not yet recognized the principle of the "virulence range."

The recognition of the "virulence range" was immediately applied in the form of our early *EDB/V* medium and when this was used we observed that there was a rapid regrowth of the meningococcus over the area from which the original growth had been cleanly removed. This observation was followed by the experiments relating to inorganic salts in the medium (Section IV (*d*)) and the relation of regrowth of the culture to potassium salts was consequently noticed.

Previously we had tried a medium described by Wadsworth (1903), a weak agar jelly, containing about seventy-five per cent of serum or ascites fluid, in which the pneumococcus maintained its virulence at a constant level for several weeks (Wadsworth and Kirkbridge, 1918); some cultures of meningococcus died quite soon and others survived for a long time in this medium. But we were struck by the advantages of the weak agar jelly and the benefit of being able to dispense with waxed plugs. We therefore made *EDB/V* medium, containing the required amount of digest and salts, but only 0·5 per cent. of agar; this medium we call "*F*." In order to have present the accessory growth factors required by the meningococcus, our practice is to dilute "*EB*" or "*EH* agar" with extract to which we have added the required amount of digest and salts, and, after adjusting the reaction, to distribute it in wool-plugged tubes under a layer of liquid paraffin and autoclave it.

We have not had this medium in use sufficiently long to be able to discuss its properties fully, but we may say that it promises well, for the following reasons: The meningococcus grows readily in it in primary culture from cerebro-spinal fluid and a profuse growth is obtained on subculture on to our ordinary medium (*EHD/V*), even when the culture is five months old. The minimal lethal dose of this culture was 2 milligrammes for 20 grammes of mouse when put into "*F*" medium and it showed no alteration in killing power in four months; after five months it killed more often than not in a 2-milligramme dose (slightly irregular) and with absolute certainty in a 4-milligramme dose for 20 grammes of mouse. This is a considerable improvement on our experience with egg medium. Furthermore we have never worked with such virulent strains as those isolated on "*F*" medium.

During the last three years we received seventeen cultures of freshly isolated strains of meningococcus from private friends and as the result of an appeal by the Secretary of the Medical Research Council and the Principal Medical Officer of the Ministry of Health. These were grown on various media of which we know nothing, nor do we know how often they had been subcultured before we received them, but the relation of

the minimal lethal dose of the cultures to the medium on which they were sent to us is set out in Table X and has certain points of interest.

TABLE X.

Minimal lethal dose for 20 gm. of mouse	> 8 mgm.	8 mgm.	4 mgm.	2 mgm.	Totals on each medium
Dorsett's egg	2	2	0	3	7
Inspissated serum	6	1	0	0	7
Trypagar	0	0	0	1	1
Unknown agar	0	0	0	1	1
EDB/N	0	0	1	0	1
Totals of each M.L.D:	8	3	1	5	17

The striking feature of these results is that no strain received on inspissated serum was virulent; but the other figures are difficult to interpret without further investigation of the problem.

We are greatly indebted to Professor H. R. Dean for his personal appeal to a wide circle of workers, asking them to collect primary cultures on our media and they have kindly consented to help us in this direction. During the last three months we have received ten suitable cultures on "*F*" egg and serum; each set having been inoculated direct from the same sample of cerebro-spinal fluid. Up to the present all the cultures on "*F*," nearly all on egg, and certain of the serum cultures have been virulent. Of these two were received from the same source as the serum cultures given in Table X.

It is yet too early to discuss these results; but at present it appears that the *primary culture* may be virulent even when the medium is not the most suitable, although on subculture its virulence may be lost. Of the virulent cultures shown in Table X, we know that the one we received on "Trypagar" was inoculated direct from the cerebro-spinal fluid.

TABLE XI.

Experiment	Generations at 24-hourly intervals	Dose of living meningococci per 20 grm. of mouse (2 mice were inoculated with each dose): 8 mgm.	4 mgm.	2 mgm.	1 mgm.	0·5 mgm.
A	1	+ +	+ +	+ +		
	2		+ +	+ +	+ +	
	4		+ +	(+) (+)	(+) (+)	(+) 0
	5	+ +	+ (+)	+ +		
B	1		+ +	+ +	+ +	
	2		+ +	+ +	+ 0	+ 0
	3	+ +	+ +	+ (+)	+ 0	
	4	+ +	(+) 0	(+) (+)		
	5	+ +	+ +	+ (+)		
	6	+ +	+ +	+ (+)		

+ = one mouse died in under 48 hours.
(+) = one mouse died between 48 and 86 hours.
0 = one mouse definitely survived.
Blank space = dose not tried.

There is one other aspect of the maintenance of virulence *in vitro* which deserves consideration. It is well known that many parasitic bacteria lose their virulence if frequently subcultured at intervals of twenty-four hours

and that the meningococcus is particularly apt to behave in this way. It is especially interesting, therefore, to notice the relation of killing power to successive subculture at twenty-four-hourly intervals on *EHD/V* medium and the results of two such experiments are given in Table XI.

These experiments suggest that it may yet be possible to produce a medium and a method of using it, which will allow of repeated subculture without loss of virulence. The fluctuations in the time the mice took to die gains in interest when compared with the fluctuations in yield of growth shown in Table II (Section III), for here again the rise and fall may be irregular after the first two generations. It is conceivable that this fluctuation in killing power and yield of growth may be determined by the proportion of dead cocci contained in a given mass of growth; this interpretation is particularly suggested by the fact that the mass representing one minimal lethal dose of killed cocci, when the organisms are entire, is very many times greater than that representing one minimal lethal dose of the given living meningococcus culture.

We readily admit that the observations contained in this section are most incomplete, but, at least, they indicate that much may yet be done by a thorough investigation of the influence of medium on the maintenance of viability and virulence of cultures *in vitro*.

VII.—Discussion.

Dopter (1921, p. 416) remarks that the immunization of animals against the meningococcus is a very delicate process which presents many technical difficulties, and this observation is emphasized by his discussion of the methods advocated by eminent authorities. There appears to be no doubt that the immunization of horses, with the object of producing a potent therapeutic anti-meningococcal serum, is by no means accomplished with any degree of certainty. Flexner, Dopter, Gordon, Nicolle and others have produced unassailable evidence that a highly potent therapeutic serum can be produced occasionally, but it is quite evident that failures have been a common experience. Similar failures appeared to us to call for a close study of the characters of meningococcal antigens and the present paper deals with part of this investigation.

A study of the literature of anti-meningococcal serum reveals no convincing evidence of any character which might serve as a guide in the production of a successful serum. The virulence of the cultures used as antigens does not appear to have been investigated, and the explanation of this undoubtedly lies in the fact that it is generally admitted that the attempted titration of meningococcal virulence has resulted in failure.

In this paper we have discussed in detail some of the inherent difficulties presented by the cultivation of the meningococcus *in vitro*, and, although we cannot claim to have made an entirely satisfactory medium, it will be admitted that we have established that the constitution of the medium exercises an important influence on the "virulence" of the culture.

We have no evidence to show how important it may or may not be to use only highly virulent meningococcal cultures as antigens for the production of potent therapeutic serums. Those concerned with the production of serums commonly express as their opinion that it is desirable to use only freshly isolated strains, but judging by their behaviour towards mice, the freshly isolated strains shown in Table X of this paper are very different organisms from those we are obtaining in primary culture on our "*F*" medium. Thus, "freshly isolated strain" becomes a term of no exact meaning without qualifying it by describing the properties of the medium. Possibly "freshly isolated" strains are more likely to represent correctly the prevalent agglutinable types.

A few months ago we started to immunize horses in terms of the degree of virulence of cultures (titrated in mice), and it is a matter for regret that this part of our investigation had to be abandoned, through circumstances not under our control, just at a time when we appeared to have mastered some of the chief difficulties in the manipulation of meningococcal virulence.

The work of Cotoni, Truche, and Raphael (1922), although dealing with the pneumococcus, bears on this question with considerable weight. In discussing the protective power of active immunization with vaccines and the production of potent protective serums, they repeatedly emphasize that satisfactory results have been obtained only when very virulent cultures were used. They even go so far as to say (p. 82): "It is impossible to obtain an active serum with an avirulent or slightly virulent pneumococcus," and (p. 78) "To prepare a multivalent serum it appears to us to be an absolute necessity to use a very virulent pneumococcus."

There is no doubt that the position of anti-meningococcal therapeutic serum still is most unsatisfactory. The identification of agglutinating types and the application of this knowledge was undoubtedly a step forward on the evidence of Gordon, Nicolle, Netter, but the production of a potent serum of any type is not a certainty. The use of virulent cultures as antigens may prove to be merely "clutching at a straw," but whether this is the case or not can only be known when the method has been tried. In any case it is important to remember that a fundamental principle of Pasteur's active immunization was to use successive doses of increasing virulence, and that we can make no claim to greater success to-day than he achieved.

The evidence we have brought forward is a step towards making it possible to test whether the virulence of a meningococcal culture bears any relation to its antigenic capacity. But for the present we must content ourselves with agreeing with Nicolle and Césari (1924, p. 76) that this information is most desirable.

We suggest that the experiments described in this paper show that the general question of culture media needs further investigation. There are certainly components in media which influence to a profound degree the

physiological state of the micro-organisms grown on them. Since writing this paper we have read the interesting work of Felton and Dougherty (1924), who show that the virulence of a strain of pneumococcus can be enormously increased by repeated subculture in milk at intervals of two to eight hours (p. 141), and that although similar subculture in meat extract or ordinary broth results only in lowering the virulence, an increased amount of "peptone" will allow of it being maintained (p. 164). This work raises the hope that with further experiment it may be possible to maintain, or even increase, meningococcal virulence by suitable cultural methods.

It still remains an open question whether the cultures we are accustomed to use may be considered to be normal healthy organisms and representative of their kind. That is to say, we do not know whether the physiological state of the organisms in our cultures *in vitro* is identical with that of those actively causing disease in their natural host. Up to the present we have not been able to detect a difference between naturally virulent primary cultures and those in which the virulence has been raised by the method described by Murray (1924, p. 194), but in both cases we are dealing with cultures.

In this respect it is interesting to note that we have seen, on several occasions, a definite early purulent meningitis in mice that have been inoculated intraperitoneally with cultures grown on our medium standardized by virulence tests. Microscopically the scanty pus was quite typical of the disease and the meningococcus was recovered in culture. One of our most striking instances of meningitis in a mouse resulted from a culture whose virulence had been raised by the *in vitro* method. But since we have not made a systematic investigation of the point, no definite conclusion can be drawn.

The special advisory committee upon bacteriological studies of cerebrospinal fever during the epidemic 1915 (Medical Research Committee, 1916, p. 20), in discussing culture media for the growth of the meningococcus, paraphrase Gordon (1916), as follows:—

"The requirements of a good routine medium for the purpose have been stated as follows:—

(1) The meningococcus must grow on it readily and with certainty.

(2) It must be easily and cheaply made and must not involve ingredients now difficult to procure in this country.

(3) It must be of such a nature that it can be stored and sent out in bulk from a central laboratory.

(4) It should preferably be transparent.

(5) The viability of the meningococcus on it should be as prolonged as possible."

Our *EDB/V* or *EHD/V* medium fulfils all these requirements quite as well and certain of them better than any of the many media we have tried. Furthermore, the evidence we have brought forward in this paper

allows us to add another very important requirement: That the medium must allow the meningococcus culture grown on it to develop and maintain the physiological characters contributing to virulence. We might also add requirements relating to the physical characters of the growth, particularly percentage of adventitious moisture.

We are only too well aware of the tentative nature of many of our observations and that a fuller investigation of many points would add to the value of our paper; but work of this nature could easily be prolonged for an indefinite time and still remain incomplete. It will be admitted, perhaps, that we have at least recognized a problem requiring solution and taken a step in a direction from which useful results may be forthcoming.

In conclusion, we wish to thank those who have kindly sent us cultures and all who have promised to do so should they get cases. We are particularly indebted to Professor H. R. Dean and Dr. Duncan Forbes, who have kindly made personal appeals for cultures to be sent to us on our own media.

Finally, we wish to thank J. Bain and E. Pleasance for their painstaking and willing assistance, which has contributed so largely to the success of the work.

VIII.—Conclusions.

(1) That it is extremely difficult to make any two batches of a given medium sufficiently alike to obtain identical cultural results with the meningococcus.

(2) That this is largely due to our insufficient knowledge of

- (a) the raw materials required, and
- (b) the relative concentrations of the ingredients necessary to afford the optimal conditions required by the organism to develop their natural physiological state essential to a successful parasitic existence.

(3) That the yield and physical characters of the growth are insufficient criteria whereby to judge a given medium as good or bad, since the killing power of a culture appears to be to a certain degree independent of these. That the present state of our knowledge requires that several characters be examined simultaneously in judging a medium for the meningococcus; such as:—

- (a) The alacrity with which growth takes place, and
- (b) The yield of growth,
- (c) The physical characters of the growth,
- (d) The viability of the culture,
- (e) The virulence, and
- (f) The maintenance of virulence with age and subculture.

(4) With the kind of medium considered in this paper, a good deal of truth is expressed by saying:—

- (a) That the virulence of the culture is chiefly affected by substances contributed by the digest;

(*b*) That the added inorganic salts, and possibly the physical state of the agar, contribute largely to the physical characters of the growth; although other factors are also concerned;

(*c*) That the yield and viability of the culture is determined by all the factors being correctly balanced.

(Elimination of by-products has not been discussed.)

(5) That there is an optimal range of concentration for tryptic digest of heart muscle, over which virulent cultures of the meningococcus are obtained.

(6) That media made with due consideration of the "virulence range" of the digest used are favourable to the viability and maintenance of virulence of the culture.

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THE OCCURRENCE OF *CULICOIDES* AS AN ECTOPARASITE OF ANOPHELINES.

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The first occasion on which members of the subfamily Ceratopogoninæ were recorded as attacking mosquitoes, was by Fearnside (1900) at Rajamundry in Madras. Since that time only two other observations of a similar nature seem to have been recorded from India proper. Gravely (1911) caught a specimen of *Culicoides* biting *Anopheles subpictus* (*rossii*) at Port Canning, in the Sunderbunds near Calcutta, and Edwards (1922) records *C. anophelis* n.sp. as an ectoparasite of *A. maculatus* from Jalpaiguri, Assam (M.O.T. Iyengar).

The records of mosquitoes being attacked by Ceratopogonine midges are, however, more numerous from the countries to the east of India. O'Gorman Lalor (1912) found such midges biting *A. fuliginosus*, *A. karwari* and *A. ludlowi* taken at Kyaukpau, Lower Burma, where as many as six per cent of the specimens of *A. fuliginosus* captured were found to be so parasitized, and in some cases the parasites were two in number on a single insect. In the Federated Malay States similar midges have been found by Stanton (1912) attacking *A. fuliginosus*, *A. karwari* and *A. hyrcanus* (*sinensis*), and Edwards (1922) records specimens of *C. anophelis*, collected from *A. hyrcanus*, *A. maculatus*, *A. aconitus* and *A. fuliginosus* by Drs. Stanton and Lamborn in the same country, as well as *Culicoides* sp., collected from *A. vagus* and *A. umbrosus* by the latter worker. The same author also mentions *C. anophelis* as occurring on mosquitoes from Sumatra, and Leon (1924) says that *Culicoides* sp. attacks *A. maculipennis* in Europe (?).[1] The exact species of midge implicated was not determined by the earlier workers, but Edwards (1922), from

[1] Seguy (1923) states that the bibliography of Ceratopogininæ sucking the blood of insects is given by Knab (1914) (*Proc. Ent. Soc.*, Washington, xvi, p. 63 and p. 139), and that a résumé of the literature on these midges biting members of the family Culicidæ is given by de Peyerimoff (1917) (*Bull. Ent. Soc.*, France, 251, 3), but unfortunately we have not been able to refer to these articles.

the study of a number of specimens and from a consideration of the earlier literature, came to the conclusion that the species involved was the same in all the records. It was a new species resembling the African species, *C. fulvithorax* Austen, and he has named it *C. anophelis*.

One of us (C. J. H. L.) was fortunate enough to collect a specimen of *Anopheles* parasitized by a *Culicoides* at Jubbulpore, Central Provinces, India, during November, 1924.

The anopheline was observed to alight on a whitewashed wall of a veranda about 10 a.m. and was easily captured. It was found on examination to have a small insect attached by its proboscis to the under surface of the abdomen. The parasite had a very firm hold and was only dislodged with difficulty; this firm attachment has been observed by other workers (Stanton, 1912; Edwards, 1922). When the specimens were killed and examined, the anopheline was found to be *A. jamesii* and the ectoparasite a female *Culicoides* indistinguishable from *C. anophelis*, Edwards.

In India, up to the present, this parasite seems to have been recorded only on the eastern parts of the country, and the present observation is apparently the first record from Central India. If the insect occurs in the western parts of India, it does not seem to be common, in the north-western portions at least, for among over 10,000 anophelines examined by one of us (J. A. S.) from those parts no instance of such parasitism was observed.

The exact effect of the midge on the mosquito is doubtful, but such a comparatively large ectoparasite must, at least, incommode its host. Leon (1924) believes that this midge, by inoculating the spores of moulds while biting, may give rise to mycotic tumours in the host, and that the lesion of the abdominal wall resulting from the bite is liable to cause a hernia of the stomach of the mosquito.

The facts that in most cases the midge attacks the abdomen of the mosquito and that it often contains blood, have caused most observers to consider that the parasite was sucking ingested blood from the stomach of its host, which view is favoured by the fact that there are no records of a male mosquito host being attacked, but Patton and Cragg (1913) think that the presence of blood in the *Culicoides* is a fortuitous circumstance and that "probably its true food is the body fluid of the mosquito, as in the case of other predaceous flies."

Stanton (1912) has raised the "interesting question as to the part that might on occasion be played by such blood-sucking flies in the transmission of mosquito-borne diseases," and proposed to make a series of observations in connexion with the possible transmission of malaria in this manner, but no further work seems to have been done along these lines.

It is interesting in this connexion that O'Gorman Lalor (1912) found that other parts of the insect, besides the abdomen, were attacked by the parasite, and that Muhlens (1921) has brought evidence to

show that the malarial sporozoites in infected mosquitoes are not confined to the salivary glands but may be widely distributed throughout the body, often in large numbers. If this is so, apart from the possibility of the midge ingesting malarial parasites from the stomach of its host, there would also be the possibility of it taking up malarial sporozoites from the organs or tissues of an infected mosquito. There is, therefore, a chance that such a *Culicoides* might become, mechanically at least, a potential carrier of malaria in this manner. This is, of course, purely in the realm of hypothesis, for there is at present no evidence even that *C. anophelis* bites man.

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Clinical and other Notes.

DISINFESTATION OF ROOMS BY FORMALIN VAPOUR.

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The question of disinfestation of buildings infected with the beg bug (*Cimex lectularius*) has been a difficult one owing to the fact that, though the adult may be destroyed, the ova have proved resistant to the disinfectants in common use. Hydrocyanic acid gas has proved effective in destroying the pests but suffers from the disadvantage of being not only dangerous to handle but also expensive.

Notice having been drawn to the use of formalin vapour for disinfection under instructions from Colonel H. P. W. Barrow, A.M.S., Director of Hygiene, I carried out a series of trials with a view to testing its efficacy in getting rid of these pests.

The formula used was chloride of lime (twenty per cent quick lime, eighty per cent bleaching powder) and formalin equal parts.

Formalin (forty per cent formaldehyde) (CH_2O) is placed in an ordinary galvanized iron pail, and chloride of lime Ca (OCl) Cl, wrapped in thin paper and afterwards pierced, is quickly added. Violent chemical action takes place immediately and about eighty per cent of the formalin is vaporized by the heat generated in the primary reaction.

Tests were carried out in seven rooms, a full account of which is given below.

Rooms 1 and 2.—Two Adjoining and Connected Rooms, Central London Recruiting Depot.

These rooms had been disinfested for bugs eighteen months previously, and they were again seen two months ago. When seen by me there was a considerable number present. The rooms are in good condition with no cracks, the bugs being present in the woodwork of the cubicles, by which the rooms are divided up, and behind the electric light wire running near the ceiling. The cubicles are eight feet high.

First Room.—Eleven feet high, total capacity 10,000 cubic feet. The woodwork at the top of the cubicle has been lifted to allow free access of the vapour.

Formalin, 14 pints, were vaporized with chloride of lime fourteen pounds, at 14.30 hours August 27, 1924, and the room opened at 10.30 hours the following day (twenty hours' exposure).

All bugs and ova visible in the cubicles were dead on opening the

room, but a few bugs were found above on the electric light wires. These were destroyed with a formalin spray.

Second Room.—Total capacity 8,000 cubic feet, in other respects like the first. Procedure carried out as before. Chloride of lime twelve pounds and formalin twelve pints being used. The results were similar to those before seen.

The rooms were taken into use on August 29, 1924, and no bugs were seen up to September 17, 1924. On this day the hot-water pipes were turned on and the temperature kept at 65° F.

On September 29, 1924, bugs reappeared in numbers.

On October 8, 1924, the temperature of both rooms was raised to 70° F., and the moisture to seventy per cent, by constantly sprinkling with water and placing buckets of water about the rooms. This was maintained till 14.00 hours on the following day when the rooms were sealed up, all cracks in the woodwork freely sprayed with formalin and fumigation started.

Formalin forty pints and chloride of lime forty pounds was used, half being placed on the tops of the cubicles. The rooms were opened at 9.30 hours on October 11, 1924, and after being thoroughly aired and cleaned, taken into use again.

The temperature was kept at 65° F.

November 4, 1924.—The rooms have now been slept in continuously since fumigation (twenty-four days ago) and no bugs have been seen.

Room 3.—No. 12a, Trevor Buildings.

The room has been completely done up recently and the bugs have only been noticed about ten days ago but are fairly numerous. The room opens directly from the living room and is used as a bedroom.

Dimensions—9 by 11½ by 14 = 1,449 cubic feet.

Disinfectant—formalin two pints, chloride of lime two pounds.

Room sealed and fumigation started at 10.00 hours, September 9, 1924. Room opened 12.00 hours September 10, 1924 (twenty-six hours exposure).

A fire was lighted before fumigation and bowls of water were placed about the room to raise the temperature and humidity. On opening the room, all bugs seen were dead including those on gas pipes running near the ceiling. The room was taken into use again immediately, two adults and one child sleeping in it.

November 4, 1924.—No bugs have been seen since fumigation.

Room 4.—No. 15, Married Quarters, Hyde Park Barracks.

Bedroom recently and very lightly infested, probably from a bed brought in from No. 16, Married Quarters. In fair condition.

Dimensions—9 by 11 by 16½ = 1,633½ cubic feet.

Disinfectant—formalin four pints, chloride of lime four pounds.

Room closed at 11.00 hours on September 29, 1924, and opened at 11.00

hours on September 30, 1924. Procedure as for Room 3. Room was taken into use again on October 1, 1924.

November 4, 1924.—No bugs have been seen since fumigation.

Room 5.—No. 11, Married Quarters, Hyde Park Barracks.

Bedroom in a fair state of repair, recently infested, but bugs numerous.

Dimensions 11 by $15\frac{1}{2}$ by $22 = 3{,}751$ cubic feet.

Disinfectant—formalin five pints, chloride of lime five pounds.

Room sealed and fumigation started at 10.30 hours on September 25, 1924.

Procedure as in Room 3, but linoleum removed from floor and woodwork from round the door.

On September 29, 1924, no bugs, but one or two live wood-lice were seen.

On September 30, 1924, the room was again fumigated.

Disinfectant, formalin eight pints, chloride of lime eight pounds.

Room closed at 10.30 hours on September 30, 1924, and opened at 11.30 hours on October 1, 1924.

November 4, 1924.—No bugs have been seen since last fumigation.

Room 6.—No. 16, Married Quarters, Hyde Park Barracks.

Bedroom heavily infested and has been so for over a year. It is in a bad state of repair with many cracks, some stopped with candle grease, and other large ones round mantel piece.

Dimensions 9 by 11 by $16 = 1{,}584$ cubic feet.

Disinfectant, formalin four pints, chloride of lime four pounds.

Room sealed at 11.15 hours on September 29, 1924, and opened at 10.45 hours on September 30, 1924.

Procedure as before, two buckets being used to hold the disinfectant, one containing formalin one pint and chloride of lime one pound was attached to a gas bracket and the remainder of the disinfectant in the other bucket was placed on a chest of drawers.

On October 2, 1924, bugs had reappeared. On October 6, 1924, at 9.30 hours the room was sealed as far as possible, a fire was lighted, with a kettle kept continuously boiling on it, water placed in bowls about the room and the door kept closed.

At 13.30 hours on the same day all cracks were well opened up and enlarged, wainscoating removed and fumigation commenced about 14.30 hours. Disinfectant, formalin six pints, chloride of lime six pounds was used.

Room opened at 9.30 hours on October 8, 1924.

The woodwork was replaced, the room distempered by the Royal Engineers and again taken into use on October 11, 1924.

Since this date it has been in continuous occupation and a fire kept lighted on October 22, 23, 24 and 25.

November 4, 1924.—No bugs have appeared since last fumigation until this morning when one was seen.

No further bugs appeared in this room and it appears probable that the bug found was imported into the quarter in some bedding brought in the day before, in the pillow of which it was found.

ROOM 7.—NO. 30, MARRIED QUARTERS, HYDE PARK BARRACKS.

Bedroom heavily infested, bugs only recently seen.

Dimensions 9 by 11 by 16½ = 1,623 cubic feet.

Disinfectant: formalin four pints, chloride of lime four pounds.

Room closed at 14.30 hours, October 14, 1924, and opened at 9.30 hours on October 16, 1924.

Procedure. On October 14, 1924, a fire was lighted early in the morning, with a kettle kept boiling on it, water placed in bowls about the room, and at 9·30 hours the room was sealed as far as possible, the door kept shut. At 14.00 hours the room was freely sprayed with formalin, sealed, and fumigation started.

November 4, 1924. No bugs have appeared since fumigation.

Four further quarters were treated in the same way with satisfactory results, all the disinfestations being carried out by Corporal C. A. Milner, R.A.M.C.

From the foregoing it will be seen that the method of disinfestation offers a reliable and safe substitute for the use of hydrocyanic acid gas, if carried out in such a way as to give all assistance possible to the penetrating power of the gas.

The points to be borne in mind with regard to this are that the gas acts most effectively at a temperature of 70° F., and when the moisture in the atmosphere reaches 70 per cent., while at the same time it must be remembered that the density of the gas as compared with air is as 15 is to 14·9 and therefore it does not diffuse readily.

It was for these reasons that the atmosphere of the rooms was moistened and the temperature raised as much as possible, while the disinfecting solution was placed in as high a situation as could be done.

A minimum of formalin two pints, and chloride of lime two pounds, is required for every 1,000 cubic feet, and the room should remain closed for at least twenty-four hours (when this strength is used a gas-mask should be worn by the operator when opening the room).

If two pints or less of formalin only are required it should be placed in two buckets, but when larger quantities are used two pints may be placed in each bucket.

ANTI-MALARIAL WORK IN ISMAILIA.

By Major N. LOW.

Royal Army Medical Corps.

I venture to write a few lines on a very ordinary piece of anti-malaria work, with a view to drawing attention to the practical importance of knowing the type of "carrier" in your station. Also, if possible, to try and ascertain as to whether *Anopheles pharoensis* is to be regarded as even a potential carrier or not.

On joining Ismailia from Palestine, in September, 1923, as Senior Medical Officer, I found that the hospital contained some fifty cases of malaria, both primary and relapse, and that the cantonment area was swarming with *A. pharoensis*, with a sprinkling of *Anopheles multicolor* (originally confused in Egypt with *Anopheles turkhudi*). With the exception of *Anopheles mauritianus* (two specimens) these were the only species of anophelines captured during the year 1923-4.

The cantonment area of Moascar merges into the town of Ismailia on the east and I got into touch with the medical officer of health, Dr. Archeroni, and we searched the areas round the town and cantonment with the following results:—

(A) Town area. Culicine breeding but no anopheline.

(B) Camp area. Culicine breeding but no anopheline.

(C) Desert north-west of camp. No breeding of any description.

(D) Gardens north-east of camp. Anophelines (*pharoensis*) found breeding in one ditch.

(E) Cultivated area south and south-west of camp. Anophelines, *A. pharoensis* and *A. multicolor*, breeding in great numbers.

The position will best be understood from the rough sketch on p. 53.

The usual anti-mosquito measures were adopted at once, viz. :—

(*a*) All sump-pits, grease traps, etc., in the camp area were oiled weekly.

(*b*) Cesspits, irrigation tanks, wells, etc., in the town area were oiled weekly.

(*c*) The ditch in the gardens east of the camp was obliterated.

(*d*) The area of cultivation, approximately 2 miles long by ½ to ¾ mile broad, extended along the Ismailia Canal, south of the camp, and abounded with drains, channels and dead-ends, all much overgrown with vegetation and teeming with anopheline and culicine larvæ.

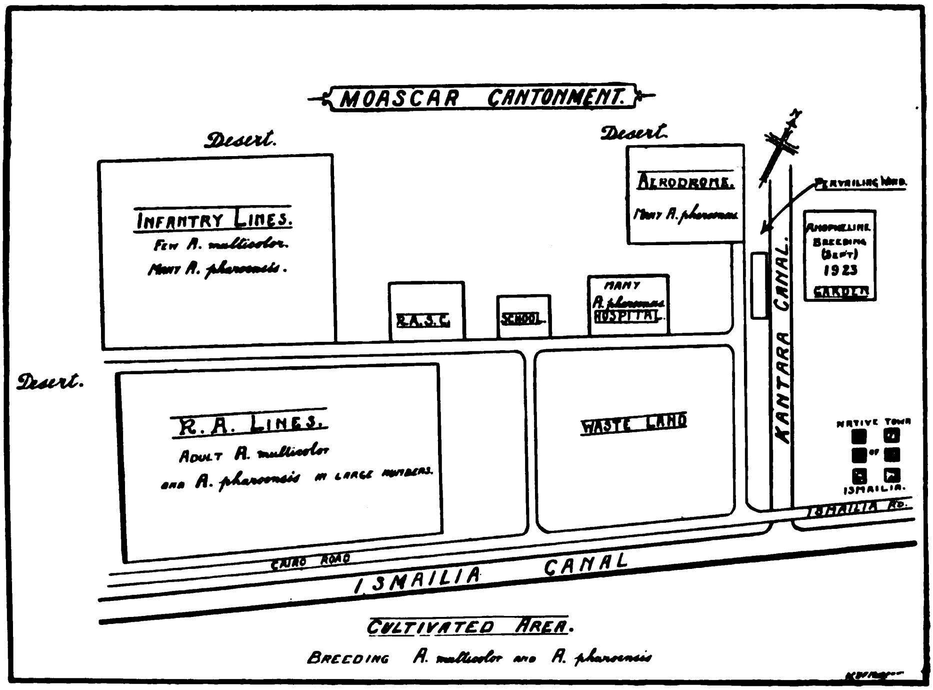
A working party of one reis and eight labourers was procured, and the worst patches, nearest the camp, were cleared by the end of November, 1923. It must be noted here that troops cannot be used for anti-malaria work in Egypt on account of the danger of contracting schistosomiasis.

Work was started again in February, 1924, when the rains had come to an end, and by the end of May the area was regarded as practically safe. The work was of the usual nature, draining when possible, removing

vegetation, allowing free passage for fish, and up to the end of September, 1923, when I left tour-expired, I had been unable to find any breeding in that area. The work was kept in order with a reduced staff (one reis and five men) through the summer.

So much for the measures; now for the results. In 1923 I captured plenty of *A. multicolor* and *A. pharoensis*. During that year there were about sixty primary cases of malaria (I write without the assistance of A. and D. books).

In 1924 no *A. multicolor* could be found, though *A. pharoensis* was



still present in great numbers, and up to September of that year, when I left tour-expired, no primary malaria had occurred.

A. pharoensis used to invade the camp from a marsh, distant about nine kilometres on the Kantara Canal. This lay in the direction of the prevailing wind, and after a strong wind they were always very prevalent.

Ample opportunities of infection were present, as the Dorset Regiment and 1st Argyll and Sutherland Highlanders, then in the station, had been heavily infected in Khartoum and India respectively, and were full of chronic carriers.

The point to which I wish to draw attention is this. In accordance with the investigations of Newstead, Dutton and Todd (1907), and Manson-Bahr (1916), there is no doubt that *A. pharoensis* can become a transmitter of malaria, in the laboratory at any rate. Yet during my comparatively short experience at Ismailia in 1923-24 it did not do so.

The only difference in the mosquito population of that station was that the comparatively small numbers of *A. multicolor* were absent.

In the "Official History of the War, Hygiene," vol. ii, p. 209, *A. pharoensis* is stated to be the common carrier of Egypt. If that be so, surely half the garrison would be continually down with malaria, as this mosquito abounds in most stations, but one knows that this is not so. Perhaps some of my brother officers have had experience of this mosquito. If it is so occasional a carrier as to be found practically safe, it is possible that a great deal of anti-malaria work may be saved.

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Sport.

HUNTING AND POINT-TO-POINT RACING IN PESHAWAR, 1922-1925.

BY MAJOR G. G. COLLET.

Royal Army Medical Corps.

INDIA used to be rightly called the poor sportsman's paradise, and although the expense of keeping horses has doubled since pre-war days, yet the keep of three horses in India is the same as of one at home.

Starting my second Indian tour I arrived in the N.W.F.P. in February, 1922, and in October got permanently posted to Peshawar; I had bought a Sagohda remount (Puck) in April and had spent the hot weather training him, and in October bought a beautiful whaler mare (Greypatch) from the Gunners at Nowshera, later on I bought a whaler mare to complete my stable. Thus horsed I started the hunting season in Peshawar in the autumn of 1922.

The Peshawar Vale Hunt country lies mostly to the north and east of Peshawar, and can be roughly said to lie between the Kabal river on the north and the Nowshera road on the south, with a small area to the south of the Nowshera road. It is a heavily-cultivated and heavily-irrigated country, with very little good going. The jumps are many and various,

small irrigation ditches preponderating; large banked-up channels make formidable on and offs, and double and treble irrigation channels running parallel form the famous Peshawar Grid, and woe to him who takes this jump too fast!

The Peshawar Vale has rarely been without a pack of hounds since the early sixties. A Hussar regiment got together a bobbery pack in 1863, but it was not until 1868 that a really level well-ordered pack of hounds was collected. Since that date the P.V.H. has been through many vicissitudes, but has always managed to keep going. From 1914 Lieutenant-Colonel Irvine, I.M.S., was Master until his death on Sunday, January 26, 1919, when he was drowned while swimming the Kabal river at the end of a great run.

The hunting season of 1922-1923 was very disappointing, the jack were scarce, and the hunt staff inexperienced; there were many blank days, and the pack was very far from level; however, we ended a poor season's sport with two rattling point-to-point meetings. There are always two annual meetings, the P.V.H. meeting and the Peshawar District Point-to-Point meeting; it is the latter meetings that I wish to describe in this letter.

The District Point-to-Point Meeting is an official army meeting organized by the G.O.C. of the District and his Staff, and the two important events in it are the team race open to the mounted units, and the team race open to the dismounted units in the district; there is a challenge cup for each unit and a silver cup to the first individual past the post. The R.A.M.C. always try and get a team together for the dismounted unit's team race, and I was given the honour of captaining the team in 1923, 1924 and 1925.

We were within an ace of winning the challenge cup in 1923 and 1925, and I thought it might interest readers to give an account of these races.

The conditions of scoring are as follows: The first man past the post scores the full number of runners as his score, the second one less, and so on down the scale; if a starter does not get home the team is disqualified, and the team with the highest aggregate score wins.

A team consists of four, and if four horses start the team has to weigh 48 stone (12 stone per horse); if ponies are ridden, 1 stone off for each pony.

The 1923 *District Meeting* was held at the Military Grass Farms, a good bit of country, with big clean ditches and excellent going; the length of course was as usual about three and a half miles.

The teams entered were two Artillery Pack Brigade teams, one Sikh Regiment, the Welsh Regiment, the I.A.S.C. and the R.A.M.C.; six teams, making up twenty-four starters.

We had in our team two heavy men and two ponies and I got in at ten stone and rode my mare Greypatch.

I can remember a scramble for the first half mile and Greypatch getting congested and bunched up, then a big jump and a banked-up irrigation channel, a heave, a huge leap and a glimpse of a man and horse below

me in the ditch and a landing. Greypatch had cleared the lot and then there were only two in front of me. Then a tremendous fight to get her round the flag, a steadying at another jump and then open country; Greypatch going her one big striding pace and leading easily. The biggest jump and a crowd of people at it, another heave and more open country—and leading by more—then a double, still leading and going strong, then open country and a clear run home: "Easy my 'Patch! we've got it on our head, if you only keep your feet," and steady does it and we pass the flag with 300 or 400 yards in hand! The next home was a Gunner, but with Gimlette, an R.A.M.C., in fourth, and McKenzie in eighth, we've got it, if only No. 4 turns up! Where is he? No luck! He is stuck two miles back at a big jump, and couldn't get his horse over: if he could have walked in we should have won easily: first, fourth and eighth.

Gimlette and McKenzie rode a gallant race and No. 4 was a gallant man to ride, and it was not his fault he never finished, but his horse, which had been lent him, was no good. The R.A. Pack Brigade won.

The cold weather season, 1923-24, was also disappointing as regards hunting, but we had some good runs and it is unfair to compare hunting in India to hunting at home.

The point-to-point season came on again. Greypatch had crashed badly with me in January, and had a big fetlock which made her unfit for many months, and she couldn't go in the race. I rode my second horse, Puck, the Sagodha remount, which I had been hunting regularly for two seasons now. He was going well, was a natural jumper, but obstinate at times.

Our team this year had of course changed. Gimlette, our No. 2, was still with us, but No. 3 and 4 had gone. Horses were also scarce, and we had many crocks in our stables. The course this year was a "hairy" one, and I must say when I "walked" it the day before the race I didn't like it a bit; there was one big jump, a ditch on to a road, a four-foot wall, with a six-foot drop the other side; we insisted that this would lead to disaster, and ruled this jump out, but the tendency was to make it a stiff course.

Twenty horses faced the starter this year. I had faint hope of victory.

We set off in a bunch, and Puck, although not as fast as Greypatch, was going well and jumping well; a mile out W——, the present M.F.H., on the favourite, fell just in front of me, and we all got bunched up at the first wall, horses refusing in all directions. They say my language here was awful; anyhow, they seemed to let me have a free jump, and Puck got over first, and I found Gimlette riding level with me; we were soon joined by Elkington, our No. 3, and a mile from home the R.A.M.C. were leading—then another wall and Puck well over, but our No. 2 and 3 had disappeared; they had both fallen. An R.A.F. officer now came level with me, and we had a ding-dong race for home, but Puck answered well and won by half a field.

Again, no luck! Nos. 2 and 3 got home, but No. 4 was very late! Nos. 2 and 3 had both ridden a most gallant race. The Royal Air Force won.

Poor Puck! Five minutes after the finish of the race I was told he was dead lame. Sure enough his off hind could not be lowered to the ground and he had to be taken home in a float. Gallant little horse, he had gone so well and won, only to suffer for many weeks in hospital. He recovered in four months and has hunted well again this season.

This cold weather, 1924-1925, the P.V.H. has shown great sport, an excellent Master with a very knowledgable staff, the country full of jack. Really good runs and jacks viewed all the time; we had a fine season's sport. Unfortunately, Greypatch threw out a splint six weeks before the date fixed for the district point-to-point, and I despaired of her being fit for the race.

The R.A.M.C. in Peshawar this year have changed a great deal. Only four members of the mess hunt, and I soon realized that an R.A.M.C. team was impossible as all our horses seemed crocked. I determined on a mixed R.A.M.C. and I.M.S. team, and after interviewing the district staff was allowed to enter a "Medical" team instead of an R.A.M.C. team. With a famous steeplechase jockey with good horses in the I.M.S. here, Colonel Kerans, I thought we had a good chance. Gimlette and Elkington, our two heavyweights, were both here, but their horses were not very sound. I reflected that with two ponies again, Colonel Kerans and myself would weigh out at about 10st. 4 lb. each, and would, with any luck, be amongst the first half-dozen home, and if Nos. 2 and 3 finished we might win; and so set about training.

Greypatch got sound just before the date fixed for the race, and I thought what luck! Then rain came, and the race was put off for a week, and she went lame again. However, I was determined to run her, as I knew the competition this year was keener than ever and that Puck couldn't live with some of the horses entered.

The fateful day came. I knew the course to be a grueller, and much of it, and thought my Greypatch in her condition would never last.

A huge field of thirty-six faced the starter, including the following teams: R. A. Pack Artillery Brigade, Royal Air Force, Rifle Brigade, Sikhs, Ghurkas, Politicals, I.A.S.C., Punjabis, Medicals.

The course was unflagged this year, and only had three or four turning points marked, and lay north of Pirbala, three-and-a-half to four miles long, as usual. A poorly-chosen course, I think, with not enough jumping and much too heavy going. Anybody's race.

However, I knew the course well, and had got it well into my head beforehand. Colonel K. and myself were to go full out and set the pace throughout, and Nos. 2 and 3 were to ride together and try and get in amongst the also-rans, as high up as they could, without forcing their horses.

It was really a terrifying crowd at the flag; the G.O.C. started

us off, and I got well away, on my dear mare, and with face set and eyes glued on the country in front of me, saw no one until I'd gone well on a mile. I was then challenged by a Gunner and we rode neck and neck, until an awkward double, wall, road and ditch faced us.

I yelled out, "We'd better go steady here, or we shall crash." I steadied, he didn't, I never saw him again! Then a big ditch and a bridge; the bridge I knew and had kept on the line of it. I saw another Gunner pull his horse to square the ditch and steady it, by that time I was over the bridge and had turned right and gained four lengths on him. I then got on to a cart track and kept to it and put Greypatch at a water-jump, she refused and I had to swing her round and crash her through a pond to the right, which she plunged into, pecked and recovered and was over. This put me back and two I.A.S.C. got level with me, my old friend the M.F.H. again, our third race together, a brief joke. "What a d—d course it is!" then a double and a crash, and he was down again. Then round the turning flag, and homewards, another 1½ miles over heavy plough, my gallant mare still in her stride, not feeling her leg, and willing to answer to any spur or rein. One more challenge from G. of the Sikhs, but nothing serious, home looming up, the mound with the waiting crowd, the last jump and the run home and the flag, my wonderful mare!

And, hurrah! Colonel Kerans second, surely we must win this time. Never had I expected a first and second possible; but oh! what's this? a riderless horse, and surely it's Elkingston's Betty; poor old chap, he had crashed and lost his horse; Gimlette home, and not last, what luck, surely we should have won this time!

Well, well, three great races, good comradeship, good sportsmen, hard riding and the wonderful satisfaction of riding good horses to victory.

I wonder if the Medicals will ever win this cup? I leave Peshawar on leave this spring; to think of more serious things, promotion exams. loom in the future; then to a new station, but my mare Greypatch will be there too.

I shall always remember these three races with great satisfaction; we had done our best, and although we'd never won the challenge cup, we had been so near it twice, our reputation as cross-country riders was well-established in Peshawar.

Travel.

A BIT OF THE BOG.

By ANDREW BALFOUR, C.B., C.M.G., M.D.

Africa is changing fast. Every year sees fresh encroachment upon its fastnesses, every decade witnesses a diminution in its big game. The iron track forces its way into the wilderness, the dissonant blast of the motor horn disturbs the solitude.

Its very diseases are in places being stamped out, many of its perils and mysteries are things of the past.

Nothing has wrought greater alteration than the war. Territories have changed hands, strange flags flutter where other standards flew, the grim necessities of battle have rendered accessible the inaccessible, have thrown open regions remote and desolate, have brought the doubtful benefits, or at least the accessories, of civilization into places where once savage Nature held unchallenged sway. Hence, ere exploitation proceeds yet further afield, it may be well to cast a look backwards and recall one wild part of Equatoria as it was not so very long ago. In many respects it remains much as of yore, but the prospector is at work and the relentless march of progress will soon set its mark even on that distant province of the Sudan, known, so it is said, in the dim past to two centurions of the Roman Empire, and now a portion of another Empire which in might and magnitude far surpasses that of the emperor whom these two soldiers of fortune served.

The Bog is no bog, save in the playful *parlance* of the Sudan official, albeit at certain seasons and in certain parts it has a right to the name in all its dreary and deadly significance. It is a great province, larger far than the whole of Ireland, a huge territory of plain and forest, aye and of hill ranges, of swamps and great rivers, and named like many another province after a water-way, a tributary of hoary Father Nile. And that river itself, sluggish, reed-choked, at times well-nigh unnavigable, is in its turn called, erroneously perhaps from a zoological standpoint, but from that of the Arab by no means unfittingly, Bahr-el-Ghazal, the river of the gazelle.

In some ways it is a dreary voyage up the Bahr-el-Ghazal and suggests the life of a bargee on some neglected canal, so narrow the stream, so still the current, so blocked the channel with vegetable growth. But what bargee ever hauled past floating islands of feathery papyrus, matted clumps of vossia grass and lightly drifting *pistia*—those tiny cabbages of the strange sudd region? And what bargee ever climbed upon the roof of his deck-house and looked out beyond reeds and rushes and yellow flowering ambatch beans upon vast green plains dotted by thousands of black ant-heaps, or on acres of oozy swamp, which in places resemble very startlingly

a level stretch among Scottish uplands carpeted by green and dying bracken? It is a strange outlook, soon growing wearisome because of its monotony, but for a time impressive by reason of its immensity and the very idea it gives of useless waste and unproductiveness. Yet is there life in it! A sudden rustle and shaking of reeds and out upon a piece of firm ground, rising a few feet from its water-logged surroundings, lumbers a great, clumsy, pink-muzzled hippo. He is so close that we can well-nigh see the bristles on him as, like some huge, unwieldy, flesh-coloured pig, he trots heavily towards shelter.

There are solid patches in the quagmire, and upon these we may see the grey and weird form of the shoebill stork, with his huge heavy beak sunk upon his breast feathers as though he meditated, or stretched before him as he flaps slowly like a heron over the morass. But it is not all swamp, and where the ant-hills are, there shall be found that most dainty of antelopes, the pretty white-eared cob.

Again, the river and its immediate verge are not devoid of life. The stern-wheeler, threshing its way up what looks like an inclined plane, dislodges from the papyrus fringe hundreds of snowy egrets, which flit in front on flapping wings, only to light and be flushed once more until, weary of the game, they break back and are lost to sight. With them may mingle sooty ibises, while every now and then a crane or heron speeds upwards with trailing legs, or ungainly grebes and darters, with snake-like necks, splash along the surface or skim across the stream to light upon the branches of some thick, possibly flowering, and certainly thorny, tree.

In the swamp belt itself are creatures of greater interest. A white patch catches the eye, something moves amongst the dense aquatic growth and field-glasses reveal a male Mrs. Gray, an absurd name for a very fine species of African water-buck. Not a true water-buck, perhaps, but a water-loving antelope with a head not unlike that of a goat and grand, ringed curving horns, a coveted trophy. The white patch is on his shoulder and must often have betrayed this wary and cunning beast. The novice goes light-heartedly in pursuit of a Mrs. Gray in country of this kind, but after half an hour of stumbling over seamed and gaping ground, of pushing through dense belts of reed, of dragging himself from miry pitfalls, of wading up to his waist, with his feet on sagging undergrowth, of sweating, panting, blowing and puffing, he begins to wonder if the game is worth the candle, and indeed if the game is anywhere within a mile of him. Frantic signals from those on the steamer scarcely aid him. His putties are black with the dust of charred grass stems, his body is bathed in perspiration, his boots squelch, and every now and then he fears he will be engulfed or that a lurking crocodile will make an end of him. It is no joke hunting the Mrs. Gray in its fastnesses, and at the end, if he is lucky enough to get within range, he must shoot straight and sure if he is to be comforted by the possession of the noble quarry.

For a space we leave the Gazelle River and run a little way into one of

its feeders, the Bahr-el-Arab, where there is a wooding station. We come upon it in a backwater, the home of countless water-lilies, surrounded on all sides by dense bush and low thorny forests and, as luck will have it, experience a nocturnal thunderstorm. Anything more unpleasant it were hard to conceive, at least on board a tiny steamer, where the cabin has a leaky roof and there is no mosquito house. The night is sultry and the stars have been blotted out by masses of black cloud. It is much too hot to sleep indoors, and shrouded by our curtains we lie on camp beds, uncovered by the sheets, trying in vain to slumber. Suddenly the wind rises, coming in fitful puffs, blowing the nets hither and thither, driving away the singing hordes of bloodthirsty gnats, which have been quartering the meshes seeking an entrance to the blood feast. A vivid lightning flash makes all clear as day for a brief moment, and then a clap of thunder, prolonged into a resonant roll, heralds the rain. Down it pours in veritable bucketfuls, each drop large as a sparrow's egg, and suddenly the fitful wind gusts seem to unite and form a small tornado. With a truly tropical howl, answered by growls and rumbles and deafening crashes, the full violence of the storm bursts upon us. Flash and crash, flash and crash! Heaven's artillery makes night hideous and awesome while wet and miserable we gather in the dripping cabin and gaze out upon the wildness of the scene. It might be magnificent were we under good cover, what with the zig-zagging of brilliant light across an inky background, the flare of electricity between contending clouds like a sudden illumination by a thousand incandescent lights, the ear-splitting thunder followed by strange mutterings, which die away only to reverberate again above and on every side. A flaming fire-ball sweeps through space and seems to plunge into the stream ,which we see for a moment covered with white-crested waves and pitted hard by from the impact of a million rain-drops.

The turmoil ceases as suddenly as it has begun. The vault clears, the stars twinkle at us once more, the air is cooler, but alas! our mosquito curtains are soaked and torn while ping! ping! the greedy hordes are busy at us. Slap and curse! So it goes on till a rosy light steals into the east and the birds ashore begin to call and twitter, and then with a bound the sun is up, the day has commenced, and we finish loading the chopped lengths of red sunt trees, bringing aboard who knows how many scorpions in the process.

We make for the main stream again, and the voyage proves full of interest. We pass a glade in the thick scrub, a space almost like a ride cut through a forest of young pine. We get only a glimpse of it, but right in the centre, moving away from us, with head slouching forward and tail swinging softly upon his quarters, paces a small leopard. It is always the unexpected which happens, and there is no rifle handy. Even had there been, it could only have been a snap-shot, for we are past the spot in a twinkling and the tree stems hide the brute, but not before we had noted how yellow was the groundwork of his spotted hide, and how indifferent

he seemed to the sound of our stern-wheel beating and churning the dull greenish water into silver streaks and silver spray.

We leave the wooded country, and again on every hand stretches the abomination of desolation, and we catch the smell of rotting vegetation, that strange dank scent, that pungent tang of putrefying growth which is perhaps the most abiding memory of all that goes to make up the once mysterious Equatoria.

So we come to Lake Fell, which was once called Lake Ambadie. After being long lost to civilization it was rediscovered by the gallant officer whose name it now bears and who gave his life in the exploration of these sudded solitudes. Its clear and shallow waters are full of fish. One can see them darting away from the steamer's bulk, and in the still of evening they rise like trout, hurling themselves into the air and splashing back again into the water. This is doubtless the tortoise meadow of which Schweinfurth speaks, for, as in his day, the coiling stalks of the African *vallisneria* rise to the surface in all directions, forming a subaqueous forest amongst which gambol the finny tribe.

It is a very fine morning when from the cabin roof we catch sight of the thatched *tukls* of the swamp-imprisoned Meshra and the flutter of a Union Jack and of a red Egyptian flag showing bravely against a background of fine umbrageous trees. It is, however, one thing to see Meshra and quite another to get close to it, for after several narrow shaves we are "sudded" at last, locked fast is the grip of the crowding, swaying papyrus, messed up amongst roots and water plants, anchored securely against our will. But if we cannot get at Meshra, there is nothing, as we soon learn to our cost, to keep the agile seroot flies from getting at us. They swarm near Meshra and, as is their way, darted on board, settling softly but very suddenly, chiefly, it is true, upon the funnel casing, but not infrequently on our unhappy selves. Watch one of these greedy blood-suckers after he has landed on your knee! He shifts a little, as if searching for the right spot, squares himself, so to speak, and then very deliberately you see his short stout proboscis sink through the thin cotton of your pantaloons. It is unlikely that you will desire to see any more of the operation, for no sane man appreciates a needle being driven through his skin. If, however, you have the fortitude to endure the stab, and some scientific curiosity, you will see the fly become bloated at your expense and marvel at the rapidity and skill with which his pumping organ works. *His* we say, but in all probability it should be *her*. A glance at the setting of the gorgeous compound eyes may tell us the sex and, as a rule, it is the female here, as elsewhere, that causes most of the trouble! There are many species of these Nile tabanidæ, and they are interesting and attractive flies, not only from their wonderfully compact shape and agile movements but on account of the glory of their colouring.

Some are dull brown or grey with lighter markings on the belly, others are a fine tawny orange with ebony points, yet others are bog-black with

snowy white spots upon them, and there are species much more remarkable but rarely encountered. In many the compound eyes are the most striking part, for these are sometimes of a vivid emerald green, a green which is almost startling in its intensity. Across these wonderful eyes bands of a pale violet may run or strips which have the blending and shifting hues of a thin oil film. It is a pity that all this brilliancy vanishes after death. Seroots arranged in a case with pins stuck through them are but dull ghosts of their former selves. The living *tabanus* is to the dead fly what the new caught herring is to the faded fish of the hawker's barrow.

But we are forgetting Meshra and the method by which we got there at last. There is only one way out of the difficulty and so overboard go a couple of our sable crew, carrying a grapnel and a length of stout rope. They plunge the flukes of the former into the dense aquatic growth and one of them climbs out upon it and squats on it, keeping the iron teeth in position. Then ting! goes the telephone bell, the stern-wheel revolves the wrong way round and we back into the clearing. There is a soft rending and tearing and then, with a sudden jerk, a great mass of papyrus is dragged out of the sedge, cast off and sent astern of us. Hour after hour the work goes on and we eat our way further and further into the heart of the belt, pushing with long poles, swinging hither and thither, crushing into the swaying growth, while the working song of the Sudanese rises upon the air with many a jest and now and then a roar of rough laughter as some unwary sailor is caught across the shanks by the tautening cable and cascades into the depths. At last we are free and haul up alongside the little jetty, where lies a large steel whale-boat, one of the very craft used by the audacious Marchand and his company of gallant Frenchmen. It is a link with the past, but we remember that in all probability those two centurions of Nero once forced their way to this very spot, and marvel again at the courage and tenacity of those who served Imperial Rome.

During the greater part of the year Meshra is situated on an island, and in order to reach the mainland a long causeway has to be traversed. It is a poor thing at the best, rotten and sagging in many parts, winding through the surrounding marsh and affording a treacherous foothold, even to the nimble donkeys and mules which form part of our little caravan.

It is after mid-day when we make the start, riding out to the unknown, our *hamla* following far in the rear and accompanied by the thwack of sticks on the lean carcasses of the baggage asses and the objurgations of their Arab drivers. Ere we have reached the further end of the causeway we have seen big game in the shape of scattered tiang or bastard hartebeeste, whose hides have the hue of old mahogany and who are well-nigh as tame as sheep. Some of the bulls lumber up on to ant-hills to watch our array, and make fine pictures, their hooves bunched like those of a chamois perched upon a rock pinnacle. Tiang beef is excellent, but for the nonce we are well provisioned and leave the herd in peace.

A few minutes later we are upon the verge of the primæval forest,

whose great canopy of dense foliage we have marked from afar. Away to our left the land is little known, a leafy wilderness abandoned to the naked savage and the innumerable birds and beasts which find shelter and sustenance within its fastnesses. It makes one think of Mowgli and the jungle folk even to look at it. Why will someone not do for the African forest what Kipling's genius has accomplished for that of India?

Perhaps the first thing that strikes one in these sylvan solitudes is the resemblance they have to woods at home. Many of the trees are like our own familiar oaks, most of them are small and they are often gnarled and twisted as the result of damage done by fire. Here and there of course a big tamarind presents a stout trunk and abundance of foreign-looking foliage; here and there the quaint sausage-like nuts of the kigelia droop from bare branches; here and there a vivid flash of colour, a scarlet poker or a crimson tuft reminds one that he is far from Europe. The big fig trees have leathery leaves and there are strangely sweet-smelling blossoms like those of the white gardenia, but, taken as a whole, the scene is wonderfully home-like, at least at a little distance. A closer inspection, however, reveals the inevitable thorniness of every dense thicket and of well-nigh every small tree, for this is a land of the acacia, of Christ's thorn and of the spiky randia, as well as of the feathery-leaved albizzia and the common hegelig beloved of my lord, the elephant.

It was on the return journey from Wau, not very far indeed from Meshra, that there suddenly stole silently and swiftly across the path a maned and mangy-looking hyæna. We were after it in a twinkling, keen to get a shot. Strange to say the brute showed no hurry to be gone, though he knew he was being chased. It almost looked as if he also knew the marksmanship was not likely to be of the best, especially when he came to a dead halt behind a thick bush. The real explanation of his tardiness was apparent only when his mate emerged upon the path with a forepaw dangling helplessly. Her consort waited for her patiently, albeit in danger of his life, and it is pleasant to think that this devoted couple of carrion-eaters departed safely together. I confess I take my hat off to the hyæna. Anyhow this specimen was a chivalrous beast and worthy of respect.

Again there was another day when, after heavy rain, the sky was clearing. Wet and disconsolate we rode along the miry track, splashing through pools where water scorpions disported themselves. For the moment we might have been traversing a bush-fringed moorland in some dreary part of Scotland. Then, like the patriarch of old, we lifted up our eyes and lo! something huge and black was standing in the centre of the road some two hundred yards in front. At first the thought of a rhinoceros suggested itself, for we had seen the spoor of these animals and were on the look-out for them. But the black and bulky mass moved. It swung broadside on and revealed itself as a solitary buffalo bull. As the sound of our approach caught his sharp ears he faced us for a moment and then paced slowly into the long grass and undergrowth at the side of the path.

Pressing forward and dismounting, we came upon him standing under a tree, a monster of bone and muscle, with a coarse coat of ebony hue plastered with mud, with a pair of great horns meeting in heavy bosses upon his forehead, with a damp, shining muzzle and suspicious little eyes watching our every movement. No sooner did he see us than he was off. A stern chase is a long chase, and on this occasion it was a hopeless one as well, for he liked not the look of us and eventually went clean away across country at a swinging trot or ever we got a shot at him.

Ere this occurred, however, one was thinking of other things than buffaloes, for, having sat for a moment upon an ant-heap, one learned what it meant to entertain strangers unawares and spend a strenuous five minutes in endeavouring to keep one's skin intact. It must be the very refinement of torture to embed your enemy up to the neck in an ant-hill and leave him to the poisoned pincers of a crawling host, as was the playful custom of not a few tribes in the Bahr-el-Ghazal!

In due course, as darkness fell, the glow of a fire and the barking of many curs told us we had reached the Dinka village of Amian, a cluster of huts and cattle kraals in a fine open glade shaded by great trees. There we off-saddled, found the well water to be very fair, and out in the open slept the sleep of the just till shortly before dawn. So great is the heat that it is needful to start before the sun is up, making a morning *shid*, as it is called, to some small halting place where there is a well containing an apology for water.

It would be but a weariness to describe every part of the way, most of it through open park-like country, some of it through places like English lanes where bright yellow star-like flowers bedeck the path, some of it past stretches where herds of giraffe are feeding. There was no end to strange and lovely birds, scattered ostriches, large ground hornbills, the rare *bucorax* wandering about amongst the grass, weird tree hornbills like imps of the air, secretary birds stalking hither and thither looking for a dinner of snakes, vultures with naked necks, pied crows and gallant, whistling kites; great and little bustard, plump partridges whirring up from the bushes, flocks of noisy, toothsome, blue-wattled guinea-fowl, harbouring parasites galore both in their blood and their intestines, but none the less succulent and well-liking. Crowned cranes with golden crests and harsh voices speed in slow-moving companies over the vast areas where they feed and roost, heavy comb-ducks, with splendid iridescent wing plumage and snowy abdomens, flight heavily towards distant pools, snipe dart out of swampy spots and zigzag to safety. Doves boom from the thickets, tick birds are busy searching for their prey on the backs of Dinka cattle, a flash of brilliant blue shows where a jay is speeding through the woodland, a bronze shrike calls like a hammer tinkling on an anvil, finches flutter in the bushes, and from the tops of high trees bell-like notes resound upon the air.

If the birds make music by day the frogs take up the chorus by night, together with countless insects which hum and stridulate. Cicalas shrill from the trees before the sun sets and while the west is still glowing like a live ember.

On such an evening we reached the rest-house of Gardain and found the Dinkas much perturbed. The night before a couple of lions had raided the miserable cattle enclosure, struck down one cow and stampeded another in the darkness. Pursuing the latter, they had killed the hapless beast a quarter of a mile away, half eaten the carcass, and were expected to pay another visit to the spot, which they duly did and serenaded us in the darkness.

It is a great lion country round about Gardain. Not long before a British officer was asleep here shrouded in his mosquito curtain. Somewhere in the small hours one of his servants wakened another and pointed out two strange lights close by their master's bed.

"Lights!" whispered the second, who was a shikari, "by Allah! those are no lights. They are a lion's eyes!"

So they were, but fortunately the brute took himself off without doing any damage or even disturbing the sleeper. Doubtless he was puzzled by the mosquito net, which that night kept out something even more formidable than an infected anopheline.

Of antelope we saw many species, the massive roan which the Arabs call Abu Rouf, the Father of Hair, in virtue of his fine mane, Jackson hartebeeste, with their queer long heads and sharply bending horns, the large Bohor reed buck, the little reed buck, the still smaller and very dainty oribi, the tiny dik-dik. Shoot a roan and you will almost certainly find ambylomma ticks clustering upon him. The males are gorgeous in their colouring, their scuta being a bright green hue edged with a fine bronze like the copper sheathing which used to guard ships' bottoms. Other ticks are the curse of the traveller, digging their rostra into his skin and hanging on with the tenacity of bulldogs. There are no doubt many snakes, but few are visible. Lizards, however, are much in evidence, some of them very quaint in shape, in colour and in movement. There is one variety in a black and orange livery who keeps bobbing up and down on his short, bowed forelegs in a ludicrous fashion, while another has a tail of cerulean blue and a tongue which for sheer agility it would be hard to beat.

At last we reach the ironstone district wherein Wau is situated and through which courses the wide Sueh river, to become the Jur ere it enters the Bahr-el-Ghazal. The scenery changes utterly; it is all forest now, real forest with creepers festooning the trees, a land of ground orchids, of glorious bulbs and fragrant lilies. The path is bordered by clumps of a a fair white flower striped with a delicate pink. The foliage meets overhead, the air is heavy and moist, there is more insect life. The narrow path winds past brakes of bamboo, we meet a Greek trader *en route* for the Nile with donkey loads of ivory. The rubber vines become a feature of the

landscape, more especially the landolphia with its spherical fruit, the pulp of which is sweet and pleasant to the taste. Trees rise out of termite mounds, other trees, such as the "kwel," spring from alien trunks; we pass the lulu, with a bark like a crocodile's hide and a nut prized for its oil. The noble Sudan mahogany rears itself above its fellows. The birds are everywhere calling and whistling, and once we see a large yellow Chacma baboon rushing man-like for the nearest shelter. Signs of cultivation appear, areas cleared for sorghum, dukhn, telabun, the sweet potato, and the earth-nuts or "puggy"-nuts of our own young days. Tobacco also is grown here, and we see natives busy in their rude fields.

All the time we are climbing a forest-clad ridge, and at last gain its summit. A brief halt to gaze for a moment over a wide expanse of tree-tops, a sea of green, and then down we plunge to the valley of the Sueh.

The forest thins, and ere long we see the picturesque little capital of the Province bosomed in foliage, and even make out the mock battlements of its pretentious new Mudiria hard by what remains of the old French fort. The whole place seems to nestle and slumber in the forest away across the flats and over the shining, tortuous river. We make for the ferry, but stop suddenly and stand agaze. What is this we see? As at every Government post in the far-off pre-war days throughout the vast territories of the Anglo-Egyptian Sudan, two flags are flying, the one the old scarlet flag of Egypt, with its silver crescent and its silver star, the other the Union Jack, in all the glory of its red and white and blue. But the flags are not mast-headed. They flutter bravely half-way up the posts. We knew that far away to the south an officer of the Province was lying ill with blackwater fever. We had heard of him at Meshra. Had he then answered the call like many a pioneer before him? Would they lower the flags for him?

We knew also that our own Governor-General was far from well in England, was indeed dangerously ill. Was it possible—?

We did not stop to think, but kicked mule and donkey into a lolloping gallop. A boat was crossing the Sueh, the ferry worked by ropes. In the boat was a white man. As he drew nearer we saw it was the Governor. Now we would know. He landed and came towards us. We scarcely wasted time in an ordinary greeting.

"What is wrong?" we asked quickly. "Why are the flags at half-mast?"

"I am sorry to say," replied the Governor quietly, "that the King is dead. He died three days ago."

It was May 9, 1910.

Current Literature.

Diphtheria. Notes for the Guidance of Medical Officers in dealing with Outbreaks of Diphtheria in Institutions and Residential Schools.

The following notes have been prepared for the guidance of medical officers in dealing with outbreaks of diphtheria in institutions and residential schools.—(*Ministry of Health.*)

A memorandum on the administration of antitoxin in the treatment and prophylaxis of diphtheria, and on the use of the Schick test and the method of active immunization for the prevention of the disease was issued by the Ministry to all medical officers of health in 1922.

The memorandum emphasizes the importance of early and effective treatment, and indicates the value of active immunization.

It should, however, be borne in mind that no new prophylactic measures can be regarded as diminishing the importance of the well-established general procedure needed for the prevention of the occurrence of the disease, and for the detection of the source of infection when a case occurs.

These methods have in the main been in use for many years, but recent investigations have indicated some modifications which are desirable.

The disease in the majority of cases spreads directly from one infected person to another by means of spray from the mouth or nose, or occasionally by direct infection from sores on the skin. In some instances it may be conveyed by means of articles, such as towels, handkerchiefs, sweets, or pencils, recently infected with bacilli from the throat or nose of a person suffering from the disease and subsequently brought into contact with the mucous membrane of susceptible persons. There is evidence that close contact is necessary, and this should make the search for, and the control of, the infecting agent a matter of no great difficulty in institutions.

Infection may be derived from a patient in the acute stage of the disease, from a convalescent, from someone who has apparently long recovered from the disease, or a person who, though never having had any signs of the disease, is the host of the germ for a period of a few hours to many months, and is capable of transmitting it. It is probable that in the majority of cases in which the infection is not due to contact with a recognized acute case, it is contracted from a recent undiagnosed case, or from a still infectious convalescent case. Thorough inquiry as to the possible origin is essential and a list of all admissions and of children and staff who have been on the sick list (commonly for sore throat) within the last three months will usually contain the name of the infecting person. Usually perhaps the name will be found among those on the list for the preceding month. It is not infrequently found that one or more mild cases of sore throat or enlarged cervical glands, or other evidence of catarrhal infection

(not diagnosed as diphtheria) precede the first recognized case of the disease.

It should be clearly realized that in a self-contained institution the first diagnosed case, in the absence of definite evidence of close contact with an infected non-resident, should be assumed to have contracted the disease (from an unrecognized carrier) within the institution; and in any event *two cases should be regarded as constituting an outbreak, and as requiring rigorous steps to trace the origin and prevent the spread of the disease.*

Some little additional trouble and slight disturbance of routine at this early period will, in most cases, strictly limit the outbreak and save much time, illness, and expense later. Pending the discovery of the infecting person, the occupants of the dormitory, ward, or other group concerned, should be prevented from coming into close contact with others, i.e., within ordinary talking distance; and such precautions as are practicable should also be taken to prevent close contact among the members of a group that has been isolated. It is important that nurses and attendants in charge of the suspects should obey the same rule. Nurses in charge of patients suffering from diphtheria may be temporary carriers of virulent germs, and should not nurse or attend to other patients, especially children. It will not usually be necessary to exclude from attendance at school any children who have not been in close contact with the actual case or group. When exclusion is necessary, the usual period of ten days should suffice. A child convalescent from an attack of diphtheria, or other form of inflammation of throat or nose, should not be permitted to associate with others until the medical officer is satisfied that the child has completely recovered clinically.

In every outbreak the medical officer of health of the district in which the institution is situated should be informed of the circumstances and his active association in the investigation invited at an early stage. In the case of children living in an institution and attending a public elementary or other school outside, the assistance of the school medical officer as well as of the medical officer of health should also be invited at once. Children convalescent from diphtheria who have to attend an outside school should not be allowed to return until they have associated with others in the institution for fourteen days without the occurrence of fresh cases. Any other regulations of the local education authority must also be complied with.

In dealing with an outbreak, any recent cases of tonsillitis, enlarged glands in the neck, nasal or aural discharge, also convalescents from scarlet fever or diphtheria, should be isolated and investigated, and swabs taken if considered desirable. Indeed, there is little doubt that outbreaks of diphtheria may often be prevented altogether if every such suspicious case is at all times effectively isolated, regardless of the report on a swab, until the mucous surfaces are completely normal and the patient has had several days' convalescence in the open air.

Swabbing is valuable in finding and diagnosing the early cases and

carriers at the beginning of an outbreak, or where no diphtheria has occurred for some time previously. Even in such circumstances it should be realized, however, that a negative report is not fully reliable in the presence of catarrhal disease; after the occurrence of several cases scattered through an institution general swabbing is not only useless but confusing. A number of carriers will always be found after even a few clinical cases, and it appears that the majority of them do not in fact convey infection, while true infectious carriers may at the time of swabbing give no bacilli. It should also be borne in mind that about two per cent of all persons in this country are believed to harbour diphtheria bacilli or germs not easily distinguishable from them. In every persistent carrier of diphtheria-like organisms virulence tests should be carried out. In the event of a reliable negative report the individual may safely be regarded as non-infectious, and no danger to the community.

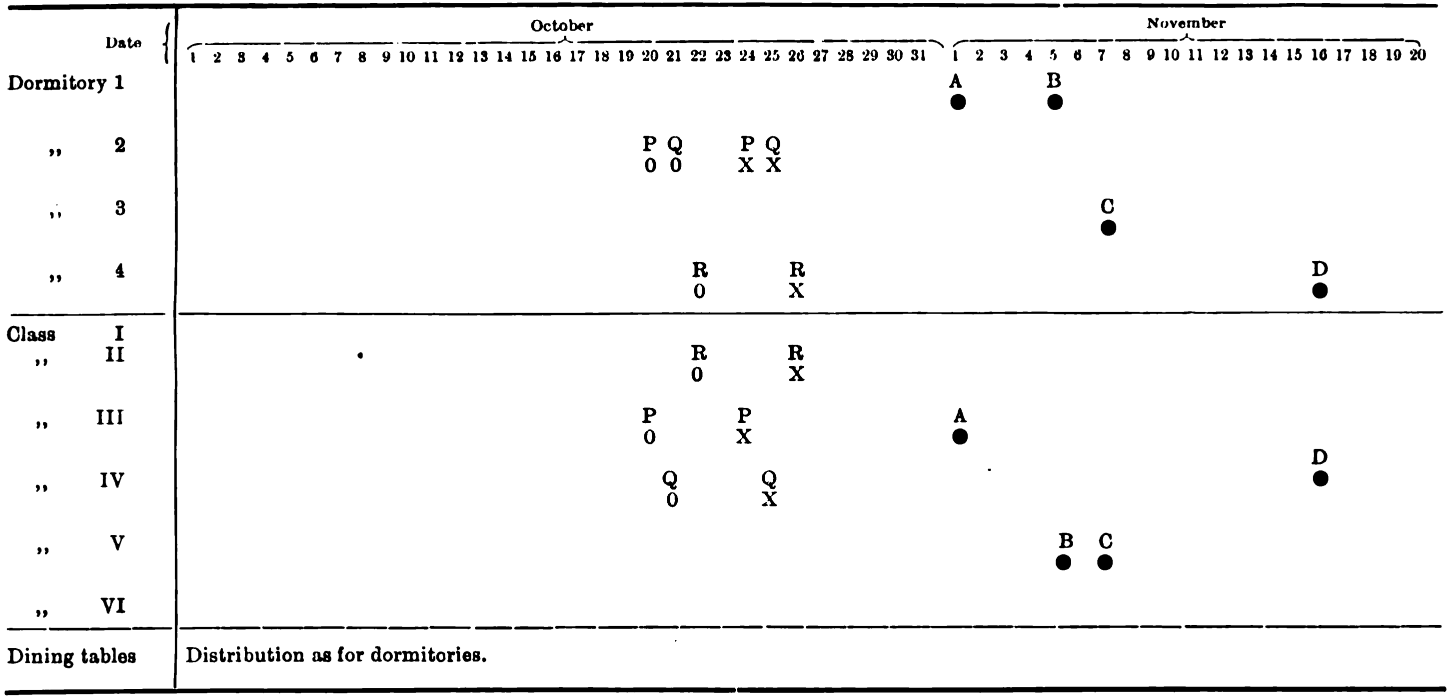
Perhaps the best method of tracing the infective carrier or carriers, when a number of cases have already occurred, is to examine the inmates group by group, and to swab all suspicious cases of discharging nose and unhealthy throat. The groups should be taken in the order in which they are placed as regards suspicion after an investigation of the distribution of the cases. If it is practicable, the cases swabbed should be isolated pending the bacteriological report. Contacts who have healthy mucous membranes and no enlarged tonsils or adenoids seldom carry infection for many days, but the large number of temporary carriers present when an outbreak has become extensive will make it difficult to deal with, and will justify drastic group isolation and daily examination in order to localize the infection and track down the carriers.

This further emphasizes the importance of taking all possible preventive action before, and at the appearance of, the first case. Experience seems to show, as would be expected, that infection is commonly spread where close contact is the rule, e.g., in dormitories, cloakrooms, vestibules, and ablution rooms, on staircases and at certain games. The risk is (even) greater when contact is continued or frequently repeated. Owing to the fact that in the school classrooms all pupils face in the same direction and are under supervision, extensive dissemination of infection is not so likely to occur there, although the occurrence of cases one by one at intervals from an unsuspected carrier is not unusual.

It will be useful to make a chronological list of all diagnosed and suspicious cases and new admissions, giving particulars as to dates, dormitory, class, etc. A useful means of tracing the method of spread and of drawing attention to possibilities that might otherwise be missed is to prepare charts showing the incidence day by day of actual and suspicious cases according to the several ways in which the inmates (and staff) associate. Thus the cases should be charted by dormitories, classrooms, dining tables, games-groups, etc. On each chart vertical columns would indicate successive days and horizontal lines the various dormitories or other groups. Different

METHOD OF CHARTING AN OUTBREAK OF DIPHTHERIA.

● = Diagnosed case of diphtheria.
0 = Case of suspicious illness.
X = Date of case returning after isolation.



A may have been infected by P in class.
B ,, ,, ,, ,, ,, A in dormitory.
C ,, ,, ,, ,, ,, B in class, though it is as likely that B and C were infected simultaneously by the same person.
(Or they may all have been infected by a previously unrecognized case).

The fact that D cannot be explained by contact with A, B or C in class or in dormitory supports the idea of a priviously unrecognized case. D is in the same dormitory as R and it remains therefore to investigate the throat conditions of P, Q and R. Of these P and Q are found negative bacteriologically, but R is found positive at the second examination and is isolated. While in isolation he infects his nurse. No further cases occur. It is found that R was intimately associated with A, B, C and D in stamp collecting, and presumbly started the outbreak. Further inquiry elicited the information that R had been out of the school and in public vehicles during the week preceding his attack of "tonsillitis."

signs should be used to indicate diagnosed cases of the disease, other suspicious cases, and cases who have returned to association with their fellows after their period of isolation. A simple specimen chart is annexed.

These charts should commence at a date at least one month before the first diagnosed case. They should include a record of every person on whom suspicion of being infective during the preceding month may have fallen. If the charts when prepared failed to yield any clear indication as to the method of spread, infection at play or other casual association is suggested. Inquiry as to the intimate friends of the patient may be helpful.

It is particularly important that contact between persons in different parts of the institution should be considered, e.g., the weekly meetings of a brother and sister living on opposite sides of the house, which is usually permited in Poor-law schools.

Careful inquiry should always be made as to infectious disease in the homes of the non-resident staff.

In the absence of special indications, school work need not be interfered with provided that steps be taken to prevent close contact on entering and leaving classrooms, and in other common school premises, but occupants of infected dormitories should be isolated from others, and all close contact at games and elsewhere stopped. In affected dormitories, beds should be so placed that there is the maximum possible interval between the heads of adjacent inmates. The intervals may be increased without altering the position of the beds by having heads and feet alternate, but the shape of a room will often be such that a greater interval can be made in other ways. Special supervision is necessary in ablution rooms, where separate towels should be provided. The "roller towel" is a potent means of spreading infection in time of epidemic, as are also pencils and slates when used in common. It is desirable that frequent and special inspection should be made of all persons taking part in the handling and distribution of foodstuffs.

Nurses and others who, by reason of the nature of their duties, are in close contact with a number of persons within short intervals of time should be regarded especially with suspicion as possible carriers.

These notes refer essentially to the control of diphtheria, but the suggestions made will also be found of value in scarlet fever prevention.

Reviews.

THE MEDICAL ASPECTS OF CHEMICAL WARFARE. By Edward B. Vedder, Lieutenant-Colonel, M.C., U.S.A. 1925. Baltimore: Williams and Wilkins Co. British Agents, London: Baillière, Tindall and Cox. Pp. xvi and 327. Demy 8vo. Price 32s. 6d. net.

The volume of the "Official Medical History of the War," dealing with chemical warfare, gives a critical historical summary of the experiences of the war and the conclusions arrived at therefrom. Lieutenant-Colonel Vedder's book is, so far as I am aware, the first attempt to provide in the English language a complete textbook of chemical warfare as it concerns the medical officer. To quote his own words: "I have attempted to gather together in the shortest possible space the information that medical officers ought to have on this important subject." With this end in view he not only draws upon the lessons of the past, but indicates possible lines of development in future warfare, both on land, and also on sea, and in the air. He introduces his readers to the subject by an examination of the facts which point to the probability of chemical weapons being used in future wars, pointing out that gas is if anything less inhuman, causes less mortality and permanent invalidity than other weapons, and if properly used is more effective and economical. He then outlines the development of chemical weapons in the European War and the development of the American Chemical Warfare Service, which is now a distinct branch of their army organization.

Four chapters are devoted to outlining the physics, chemistry, meteorology, and characteristics of toxic clouds and smokes, which are essential for the medical student of chemical warfare to know. His classification of chemical agents is that adopted in the "British Official Medical History."

There is naturally nothing new to add to the descriptions of the pathology, morbid anatomy, and histology and clinical signs and symptoms of the pulmonary irritant substances, which have already been published both in this country and in America, but the information given is well arranged; in particular, in the section dealing with the production of anoxæmia, the factors which determine the clinical condition are clearly and logically set forth.

It is noticeable that secondary bacterial infection of the lungs appears to have been more common in American than in British experimental observations. This may be due to the fact that a great part of the American work was done on dogs, whereas British observers used most frequently goats, cats, rabbits and guinea-pigs.

As the result of research in the Medical Division at Edgewood Arsenal—the American Chemical Warfare Station—Colonel Vedder lays down the following programme for the treatment of phosgene poisoning :—

(1) Counteracting the immediate effects of the gas (causal treatment).
(2) To reduce or limit the amount of pulmonary œdema.
(3) To prevent the concentration of the blood.
(4) To relieve the anoxæmia.
(5) To support the heart and circulation.
(6) To relieve subjective distress.
(7) To prevent infection and subsequent pneumonia.

Under (1) he mentions inhalations of ammonia, but considers such do little good, and may do actual harm. This is in agreement with post-war British views.

He has, however, found (in dogs) that injection of urease, a ferment which acts on the urea of the blood, liberating ammonia, exerts a beneficial action when injected immediately after gassing. It presumably acts by neutralizing the acid from the inhaled gas. The urease is prepared by making a 10 per cent. watery solution of Jack (soya) bean meal. One cubic centimetre of this solution is injected for each ten kilos of bodyweight, i.e., about seven cubic centimetres is the dose for an average man. It is claimed that in dogs so treated the onset of pulmonary œdema is delayed.

(2) Fluid escapes into the lungs from the great dilatation of pulmonary capillaries and resultant stasis. According to Vedder urease produces a temporary constriction of these vessels, but emetine prolongs it for a considerable period.

So far as I am aware, British observers have not yet found any drug or substance which is of proved value either in the prevention of œdema or neutralization of acid in the lungs.

(3) Injection of gum glucose solution up to a strength of 25 per cent is recommended to prevent concentration of the blood. Vedder states that if this injection is given soon after gassing (one to two hours), animals receiving a lethal dose of phosgene may be saved by this treatment alone, and that it is much more efficient than venesection.

Under (4) (5) and (6) the treatment recommended differs little from that adopted by British authorities.

In discussing the late effects of asphyxiant gas-poisoning the author states that cases with spasmodic asthma are suffering from polycythæmia. This appears to be putting the effect for the cause. The polycythæmia is Nature's endeavour to compensate for prolonged oxygen deficiency.

The physics and chemistry of mustard gas dichlordiethyl sulphide and the current theories as to its mode of action on the body are discussed at some length. The Americans seem no nearer to a full understanding than British or Continental observers.

The author, therefore, merely states current theories, summarizing the points for and against them. A full description of the clinical picture

and morbid anatomy follows. The view that mustard has a systemic as well as a local action appears to be favoured, a view as to the accuracy of which British observers have not yet been able to satisfy themselves.

A certain number of individuals are hypersensitive to the action of mustard gas, and Vedder considers that such persons should not be allowed to participate in operations in areas where mustard is present, since they will inevitably become casualties. They should be eliminated by means of a mild test, wherein a drop of very dilute mustard ·01 or 0·1 per cent in absolute alcohol is placed on the forearm. The individual who reacts definitely with ·01 and very strongly with 0·1 per cent is hypersensitive. An individual who does not react to 1 per cent is very resistant. The normal man reacts definitely (erythema) to 0·1 per cent. About 78 per cent of negroes are said to be resistant.

Vedder considers that protective ointments are either totally useless, or have a very limited value. He recommends for first-aid treatment of skin burns repeated sponging with a solvent such as alcohol, kerosene, or gasoline, and thorough washing with soap and water. Should such solvents not be available the affected parts should be washed with an aqueous solution of chloride of lime, or with Dakin's solution.

This treatment is in accordance with current British views, but it must be remembered (*a*) that unless the preliminary solvent is thoroughly removed it may wash dilute mustard into crevices round the nails, or in folds of skin, and (*b*) that repeated application of chloride of lime is apt to produce a chronic eczematous condition.

The American treatment for burns which have developed and for lung and eye lesions is similar to the British.

A section is devoted to the American chemical vesicant, Lewisite-B-chlorvinyldichlorarsine, which has not yet been used in war. Its action is similar to mustard. Treatment for skin burns from actual liquid contamination is the application of a 5 per cent aqueous solution of caustic soda, followed by washing with water. Vapour contamination may be treated by colloidal ferric hydrate paste in glycerine.

The lachrymators and sensory irritants are dealt with in detail, the advantages of chloroacetophenone being emphasized.

Protection is considered under the headings individual and collective. The section on individual protection is largely devoted to a description of the American respirator, of which the face-piece is a modified Tissot type.

The Americans have designed a special mask for the protection of individuals suffering from head injuries. They have also a special container for use in atmospheres where carbon monoxide is present.

It is stated that the American Chemical Warfare Service has developed a compound called "impregnite" which destroys mustard gas. Ordinary clothing may be impregnated with this compound, and it is stated that if so treated it will neutralize mustard for several hundred hours under field conditions.

Collective Protection.—The organization of the American army for chemical warfare is well advanced. In addition to the Chemical Warfare Service, in which there are medical representatives, and which supervises all training, each unit has its own gas officer and N.C.O.'s. Their work is limited to unit defence.

For cleansing personnel contaminated by mustard, mobile bathing units are available—two to each division. The unit consists of (1) one motorized bathing truck, (2) one three-ton truck of standard make for transporting clothing and equipment, (3) one motor-cycle and side-car for the commanding officer, (4) one fifty-foot ward tent for cover.

Its personnel consists of: One captain or lieutenant, Medical Corps; one serjeant, first class, Medical Department; two serjeants, Medical Department; seven privates, Medical Department; and one private, chauffeur.

The unit is divided into (*a*) reception department, (*b*) bathing and irrigation department, (*c*) clothing and evacuation department. It carries 500 sets of clothing.

The methods of cleansing clothing and equipment contaminated by mustard are similar to those used by the British.

The author emphasizes the need for protection of food and water supplies and forage.

In dealing with medical organization for handling gas casualties, Colonel Vedder states that it is practically impossible to have a definite table of organization detailing personnel at the various aid stations. Any such organization must be extremely flexible. He emphasizes the need for every medical officer and orderly to have a thorough knowledge of the latest treatment of chemical warfare casualties, and says that this knowledge will in future be just as necessary and important as that of the proper treatment of wounds and fractures. He outlines the type of equipment which should be in each medical station on the route of evacuation, and gives in some detail the organization of a gas collecting station. He does not attempt to estimate the number of casualties from chemical weapons, but states when troops advance or retreat rapidly (open operations) gas casualties decrease in relation to gunshot casualties. When troops offer resistance (French operations) gas casualties increase in relation to gunshot casualties.

This statement, while true for operations where gas is used in a manner similar to the last war, may prove far from accurate as gas tactics develop and higher concentrations are obtained in the field.

The ultimate results of gas-poisoning are discussed at length. The Americans have probably investigated this subject more fully than any other workers since the war, and their conclusions are valuable for those dealing with pensions claims. These conclusions are summarized as follows:—

(1) That only a minute percentage of persons have suffered from any permanent disability directly caused by gas.

(2) There is not the slightest evidence that gassing has increased the liability to tuberculosis; so far as the evidence goes men who have been gassed suffer less from tuberculosis than normal individuals under the same circumstances.

(3) That neurasthenic conditions are responsible for a considerable part of the disability alleged to result from gassing.

(4) That few of the cases that receive a pension will ever admit a subsequent improvement or cure.

The chapter dealing with the "Naval Medical Aspects of Chemical Warfare" is written by Lieutenant-Commander Duncan C. Walton, M.C., U.S.N. As chemical weapons, other than screening smokes, have not hitherto been used in naval warfare, the description of naval defence and medical· tactics is simply an anticipation of what may happen. The functions of the naval medical officer as outlined overlap those of the gas defence officer. The writer, however, emphasizes the importance of systematizing the distribution of first-aid appliances to those parts of the ship which may be cut off by gas from the sick bay, and the necessity for making vital stations on shipboard gas proof.

A description is given of the casualties which may occur in submarines from arseniuretted hydrogen or carbon monoxide, and of those which may occur in any ship when disinfecting with hydrocyanic acid gas.

The last chaper in the book deals with treatment of respiratory complaints by inhalation of chlorine, on which Colonel Vedder has done much work and by which he claims to have obtained good results.

This book is a valuable addition to the literature of chemical warfare, and will repay study by those responsible for administration and organization in war. This method of warfare is bound to modify greatly existing medical strategy and tactics, and the problems to be solved in the field are clearly put, though one may not entirely agree with the methods proposed for their solution.

The book is written in a pleasant style and is well illustrated.

W. R. G.

SIR EDWIN CHADWICK. By Maurice Marston. London: Leonard Parsons. Small 8vo. Price 4s. 6d.

This small volume is one of the Roadmaker Series, and is devoted to a review of the life and work of Edwin Chadwick. Many honoured names stand out as great reformers in the social history of the first half of the nineteenth century, and certainly not the least is that of the subject of this memoir. It was a period of swiftly moving events, great social upheavals, and tremendous advances in knowledge, a time when old ideas died hard and new ones were impatient to take their place. Protection gave way to the beginning of Free Trade, slavery was abolished, the repeal of the Combination Laws was followed by the birth of trade unionism, and Chartism rose out of working-class discontent.

Born in 1800, Chadwick worked and agitated throughout that critical first half of the nineteenth century, and at the end of his ninety years of life was able to see many of his ideas fulfilled, for the developments that have resulted from his work are manifold. It was Chadwick who first perceived that no individual can be expected to perform his private work and at the same time be held responsible for his town's drainage, water supply and sanitation. These matters must be seen to by a corporate body, elected by the population of the area, and the interest of that body should be the welfare of the inhabitants. It was Chadwick who first faced the problem of efficient local self-government organized from a central office. It was Chadwick who first conceived the idea of the State's duty to the individual by the appointment of factory inspectors. He saw that with the advance of industrialism and the scramble for increased production some system of governmental regulation was necessary. These we are familiar with in our various Poor Law, Local Government and Factory Acts. Finally, it was Chadwick's greatest achievement that he forced on a dense and unwilling people his "sanitary idea." That is, it is to him we owe the familiar axiom of to-day—the idea that people are materially affected by environment. He proved to the world that it is impossible for men and women to live clean and sober lives, or to work well and honestly under conditions of squalor and disease. Needless to say, his ideas were met with abuse, but eventually he gained a hearing, and, by common consent, Edwin Chadwick is acknowledged to have been the greatest pioneer in modern sanitary science.

In spite of the great good which resulted from his agitations, it must be admitted that Chadwick was not an attractive personality. As a barrister and journalist his early years were embittered, and when he came to formulate his ideas and press them upon an unwilling people and Government, he did so with an astonishing want of tact. He was obsessed by a hatred of disorder and incompetence; obstinate to a degree he liked to impose his will on others, and although he had a gentle and generous heart, he never allowed his heart to rule his head. He was too much in a hurry, and failed to see that the evolution of reform travels at the pace of the slowest mover; but as a great administrator and advocate of the paid expert official, working for the cause of efficiency and order, he stands a head and shoulders above his contemporaries. The curious defects of his character were manifest to the end, for after he had retired from public life, and medical science was advancing, Chadwick, the reformer and agitator, became a reactionary, and more obstinate than ever. The new knowledge arising from bacteriology was anathema to him. To Chadwick cholera was still nothing but a smell, and germs the inventions of doctors. And this attitude was the attitude of a man who said "the great crime of this class of practical men is their dishonest dealings with evidence, shutting their ears to it, and when it is forced upon their perception deprecating it." It is an interesting aspect of human psychology.

This volume well deserves its place in the series to which it belongs, and we congratulate Mr. Marston upon the manner in which he has surveyed the life and work of Edwin Chadwick, the man who, recognizing the social evils of his day, did not hesitate to agitate for their reform, and press forward schemes to replace them. Some of his schemes may have been mistaken ones, but many of the improvements for which he agitated are still in force to-day. R. H. F.

MILITARY GEOGRAPHY OF THE BRITISH COMMONWEALTH. By Major A. E. W. Salt, Army Educational Corps. Gale and Polden. Price 10s. net.

It would be interesting to know how many readers of either this or any other journal ever give a thought to or have any clear idea as to how our great Empire was founded and built up, or have any clear picture of our possessions, communications, trade, &c. Possibly few. To rectify the situation we have here a book whose every page is full of facts of interest, so much so that it is practically impossible to review it in detail. Written originally as a help to officers undergoing instruction at the Staff College, the book makes a wider appeal to those who believe in our Commonwealth and its future and are interested in the problems which it presents, both as to economics and military strategy. From that point of view the book is worthy of study by every citizen, and having read it, of serious reflection. Having done so, no one can fail to receive the impression that the builders of our Empire must have been very great men whose actions and judgments were sound, and moreover, men who never feared responsibility. What those men built, and the problems associated with its maintenance and defence, are well outlined in Major Salt's book, and for those in search of a mass of interesting facts in a very readable and condensed form they are to be found in this volume. R. H. F.

Notices.

EDITORIAL NOTICES.

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Obituary Notice.

LIEUTENANT-GENERAL SIR W. L. GUBBINS, K.C.B., M.V.O.

By COLONEL SIR ROBERT FIRTH, K.B.E., C.B.

With genuine regret we heard of the death of this officer which occurred somewhat suddenly on July 8, 1925, at Westgate.

William Launcelotte Gubbins was the son of the Rev. George Gubbins, Prebendary and Chancellor of Limerick, and was born on July 26, 1849. His secondary education was received at Trinity College, Dublin, where he became Erasmus Smith scholar, taking honours in history and literature, and finally graduating as M.B. in 1872. He elected to pursue his profession in the army and was gazetted surgeon on September 30, 1873. He was soon sent out to India, where he served chiefly in Bengal. On the outbreak of the Afghan war in 1878 he proceeded with the 1st Battalion 5th Fusiliers (now Northumberland Fusiliers) and was in medical charge of that unit during the prolonged operations in the Bazar Valley. Later, he was transferred to Divisional Headquarters and became Divisional Sanitary Officer and Secretary to the P.M.O. of the Field Force. In these capacities he saw much of the fighting in the Khyber Pass and associated operations against the Mohmands and Gilzais. His experiences at this time gave Gubbins an insight into the difficulties and needs of sanitary effort among troops, and doubtless were the foundations of his subsequent attitude and interest in problems which were to loom large in after years when he had risen to administrative rank.

At the end of the Afghan war Gubbins came home but soon found himself serving in Egypt with the Expeditionary Force under Wolseley in 1882. After this, he returned to England and did duty at Warley until he was sent out to India again in 1885. During this tour his services during a severe outbreak of cholera in Allahabad Fort were especially brought to

the notice of the Government of India. By this time, Gubbins had been promoted to surgeon-major, and returning home in 1890 soon found himself doing duty at Woolwich where he was Secretary and Registrar to the Royal Herbert Hospital. In 1895 he was transferred to the War Office and during his period of duty in A.M.D. 3, the whole medical equipment of the army was re-organized and plans developed for medical services in relation to Home defence. In this work Gubbins played an active part which received high praise from the Director-Generals of the period, McKinnon and Jameson. The times were then a critical era in the history of the Army Medical Service, for the rank controversy and unpopularity of the service were acute.

In 1898, Lord Lansdowne, by an act of high statesmanship, cut the Gordian knot and formed the Royal Army Medical Corps with army ranks from private to colonel. Gubbins at this time was a Lieutenant-Colonel and Assistant Director-General at the War Office and had much to do with the new scheme, into which he threw himself whole-heartedly as he did concurrently into the work of a British Red Cross Committee under Lord Wantage, for the development of voluntary medical aid, upon which he served with marked success. No sooner had this work been completed than the South African War broke out. Gubbins was sent there in 1899 as P.M.O. to the 6th Division, with local rank of Colonel. He accompanied the division to the relief of Kimberley and was responsible for the medical administration during the operations covering Paardeberg, Poplar Grove, Driefontein and the entrance into Bloemfontein. Later, he did further service in the Orange River Colony and Transvaal, being P.M.O. at Pretoria, Pietersburg and of the northern line of communications when the troops passed to the high veldt. During this period, Gubbins showed great ability as an organizer and administrator of the service which was then being severely tried by the widespread prevalence of enteric fever. This service was duly appreciated by Lord Kitchener, who was then in command, and the promotion of Gubbins to substantive rank of colonel quickly followed.

On the termination of the Boer War Gubbins came home and was appointed medical chief of the Home District. Here his abilities as an organizer and administrator were soon tested by the arrangements associated with the coronation of King Edward VII, when large concentrations of troops in London were made. All his work in this connexion was good and Gubbins was awarded the M.V.O. and promoted soon afterwards to the rank of Surgeon General. In this capacity he went to India, where he was P.M.O. of the Bombay district and afterwards of the Eastern Command.

In 1906 Gubbins was transferred to Simla as P.M.O. of all India. In that office he soon made his influence felt, tackling with characteristic energy many problems connected with the health of the soldier, and receiving the C.B. In 1908 he was relieved and transferred again to the War Office as Deputy Director-General. On the retirement of Sir A.

Keogh in 1910, Gubbins became Director-General and also Honorary Surgeon to the King and was promoted K.C.B. in 1911. Some of his best work was done during his tenureship of the Director-Generalship, as he there and then had full scope for his views and activities in the various fields in which he was interested. During his tenure of this office he raised the physical standard of recruits and soldiers by initiating more careful medical inspection and lowered the percentage of rejections by means of broader views as to the interpretation of tests for recruits. He took a keen and practical interest in sanitary effort in the army, especially in the direction of fostering sanitary knowledge among officers and men, a movement initiated by his predecessor; he encouraged inoculation against enteric fever and took a strong interest in developments of modern and improved methods of treating syphilis and venereal disease. The results of this policy were soon manifested by the reduced admission to hospital rate and the lowered number of days during which men were in hospital. The death-rate from all causes throughout the army also was definitely lowered. In developing these and other reforms and changes for the better, Sir Launcelotte Gubbins particularly made his influence felt on the Army Medical Advisory Board, the Army and Territorial Nursing Boards and the Advisory Committee on Voluntary Aid, of all of which he was chairman. In appreciation of his good work in these various directions, he received the full approbation of his colleagues in the War Office and also of all officers and men in the service which he so ably administered, while Trinity College, Dublin, awarded him its honorary M.D., and the Royal College of Surgeons in Ireland its honorary Fellowship. In June, 1914, Sir Launcelotte Gubbins retired, on the expiration of his period of office as D.G.

During the Great War he held various posts, being temporarily re-employed from June 23, 1915, but his chief work was in connexion with the British Red Cross Society. Towards the end of the war he was given the Reward of £100 per annum for Distinguished and Meritorious Service. He also continued to act as an *ex-officio* Commissioner of the Royal Hospital at Chelsea, in which work he maintained a keen interest to the end. In his earlier years he married Florence Margaret, second daughter of the Rev. H. Tripp, formerly Fellow of Worcester College, Oxford, and with his wife and daughter settled down, on retirement, at Wimbledon, where he was a county magistrate and held in high respect and esteem. He identified himself with the fortunes of the Royal Wimbledon Golf Club, where he served on the Committee and will now be missed as a kind-hearted member. For many years he had been a Vice-President of the Army Medical Officers' Widows and Orphans Fund, and was constant in attendance at the meetings of the Committee, where his shrewd common sense and sympathetic attitude were much appreciated. He is survived by his widow and daughter, having lost two sons some years ago. His funeral took place at Reigate Parish Church on July 13, 1925.

Such, in brief, was the career of Sir Launcelotte Gubbins, and, in thus recording his death, it may be said that the State has lost a good and loyal citizen and the army medical service in particular an able, loyal and sympathetic comrade. Sir Launcelotte did not contribute much to professional literature, but he was ever up to date and in touch with all the changes and advances made in its scientific developments and always keen to apply them to the benefit of the soldier and the credit of the service in which he had passed his working life. Kind-hearted and endowed with sound common sense Sir Launcelotte will be much missed, for he was a man of unusually wide culture and great experience.

AN APPRECIATION BY LIEUTENANT-GENERAL SIR CHARLES H. BURTCHAELL, K.C.B., C.M.G.

I desire to pay a tribute to the honoured memory of the late Lieutenant-General Sir Launcelotte Gubbins. In doing so I write of him not by repute, but by the intimacy of daily intercourse with him for more than four years, during which time I was Assistant Director-General under him at the War Office. The late Sir William Babtie, then Deputy Director-General, and myself were with Sir Launcelotte throughout the whole period he was Director-General. Other officers served with him while he held that position for various periods, and I am confident I correctly represent the sentiments of every member of his staff in those days when I say that we all sincerely regarded him as a friend, and felt towards him both affection and esteem. Everyone who had a superficial acquaintance with Sir Launcelotte will remember him as a big man in body, emphatic, and sometimes a little brusque in speech, and, perhaps, on occasions slightly impatient with slower-witted men. We who were in close touch with him and saw the inner man knew that under his strong and independent character he possessed a big sympathetic soul and real kindness of heart; that his temper was always the same and that he was affable, generous and indulgent. Sir Launcelotte's well-balanced practical mind, abundant common sense, extensive reading and knowledge of men and affairs enabled him to focus his vast experience in a wide range of military medical positions to the best advantage in the solution of any of the diverse problems he was called upon to solve. All who had to take his directions appreciated his power of clear decision and his wise counsel, which, not infrequently, was associated with evidence of a fine sense of humour—especially when he had occasion to consign to just contempt or oblivion some impracticable proposition. Of all men our Chief knew his own mind and stuck to his decisions and his views.

In questions of policy he invariably set his own standard, and he was never carried away by illusions of imagination or allowed himself to be advised or pressed from any quarter to adopt a course in which he did not believe, but, once convinced of the wisdom of a particular line of

action he pursued it with resolute courage and without fear of criticism. His tact and steadfastness of purpose were often invaluable. In difficulties he always knew the best thing to say or do, and on occasions, when pushing the merits of a case he gave delightful demonstrations of skill in official procedures, and of the ingenious use of all the honourable and innocent artifices for the disentanglement and defeat of red tape. In appraising the merits and aptitude which Sir Launcelotte displayed in his position as Director-General in the year 1910 and the following years, it is necessary to realize the revolutionary nature of the changes that took place since he was first commissioned thirty-eight years previously—in 1872, when the regimental medical system and long-service were condemned but still in force—not only in the constitution of the medical service, but also in all branches of medicine and their application to the necessities of armies. To have kept touch with progress along both lines of the evolution, and to have controlled the medical affairs of the army with the ability he displayed as Director-General indicate great qualities and an uncommonly keen intellect. He often spoke of his early years of service, which had made a deep impression on his observant mind. His career started in the days of dispersion of medical effort among fighting units, and he had experienced the disadvantages and disabilities from which the medical service, and through it the army, suffered before the formation of the Royal Army Medical Corps. He never ceased to impress upon all the value of the Corps and its possibilities, which he held were based on complete cohesion between officers and other ranks, and co-operation and understanding between those employed on the different phases of work falling to the lot of the Corps. So strong were his views on this subject that he devised and set in motion, so far as lay within his power, methods of propagating amongst officers warnings of the dangers and weakness liable to arise from dispersion of elements or individuals. He believed in concentration of effort towards a common objective and upon that principle he considered the Corps must rely for the effective fulfilment of its purpose.

No Director ever gave more time, care and forethought than Sir Launcelotte to issues he was in a position to influence for the well-being or comfort of all categories of personnel. When the interests of an individual were at stake, he was never influenced by friendship or by enmity and no decision of his was ever based on any motive other than scrupulous fairness and plain honesty.

The progress made in the training of all ranks of the Corps during the four years Sir Launcelotte was Director-General, is still fresh in the minds of many, and to him is due in no small degree the credit for the state of efficiency of the Corps when mobilized for the Great War just two months after he ceased to be Director-General. Such shortcomings as came to light during the early months of the war cannot be attributed to want of foresight on the part of Sir Launcelotte, and it must not be overlooked

that he had initiated a proposal for the adoption in certain positions of motor ambulance transport. How that proposal failed to mature before war broke out cannot be told here.

Eleven years have passed since Sir Launcelotte ceased to be Director-General and we bade him an official good-bye, but time and the momentous events of the war and its aftermath have not modified my recollections of my Chief or the impressions I received while serving under him. He will ever hold a high place in my memory and my affections, and I am sure that all who were eye-witnesses with me of his control of the Royal Army Medical Corps will agree that he displayed high skill in steady navigation and that he piloted his ship clear of rocks and currents, improved her from stem to stern, never jettisoned an ounce of valuable cargo and handed her over manned by the best crew she had ever carried.

Off duty and relaxed from the stress of work, Sir Launcelotte was a lovable, kindly man with a fund of good stories. He was a great reader of history and biography and had a remarkable power of apt quotation. He was a delightful and finished after-dinner speaker. Many will remember him at the College Mess and especially at the banquet there on the occasion of the International Medical Congress; but I have listened to him at wider public gatherings and seen him take a high place amongst some of the most experienced speakers in the London of his day. Those of us who served with him at the War Office will never forget the inspiring sight of our revered Chief emerging into Whitehall on a summer's day en route for some gala event. He was a notable figure of magnificent proportions with a debonnaire distinction and smartness that no one else could equal—his top hat had a special curve, his morning coat a distinctive cut and his white carnation a peculiar pose—and all went to increase the dignity and stateliness of his rolling gait which made the passers-by instinctively move aside to allow someone evidently of importance to pass.

God bless his memory and may he ever rest in peace.

Original Communications.

THE PURIFICATION OF WATER SUPPLIES ON FIELD SERVICE: A RETROSPECT.

By Colonel Sir WILLIAM HORROCKS, K.C.M.G., C.B.

In Volume I of the "Hygiene of the War" [1] there is a short account of the methods employed for the purification of water a few years before the outbreak of the Great War, and a brief statement of how chlorination came to be adopted as the routine method of sterilization during the war. In view of the interest which has been manifested recently in the subject of the chlorination of water, it may be helpful to give more detailed information of the experimental work which led us, in 1914, to adopt clarification by means of an alum precipitate on a specially prepared cloth and sterilization by chlorine derived from chloride of lime.

When I was appointed expert in sanitation on the Army Medical Advisory Board, I made numerous experiments with artificially polluted London tap-water, and with ordinary polluted waters from various sources, using the official water-cart, which had clarifiers made of compressed sponges and sterilizing candles of stoneware material fixed in metal caps. I found there were three grave objections to the official cart: (1) The compressed sponges did not act as efficient clarifiers, and soon permitted the passage of fine suspended material, which blocked the pores of the candles and rapidly reduced the output of water. (2) It was impossible to ascertain by naked-eye examination that the stoneware candles and the material fixing them to the metal caps were free from flaws which might allow the passage of bacteria. Numerous tests were made with air under pressure, the candles being immersed in water, but we reluctantly came to the conclusion that though air-pressure was a good enough rough guide to enable gross lesions to be detected, yet the only reliable test was a bacteriological examination which would be difficult during times of peace and impossible during war. (3) It was difficult to secure that the junction of the candles with the cap of the cylinder would be sufficiently tight to prevent the passage of bacteria. The candles could be washed free from deposit without removing them from the cap, but twice a week they had to be detached and boiled in water. Moreover, the arrangement of the taps and pipes on the cart was somewhat complicated, as water had to be first pumped through the clarifier into the main tank, and then pumped from the tank through the candles. For service purposes the fewer taps the better; every tap and connexion is a source of weakness, especially when the water-carts have to travel over rough roads.

Troops on the march should have a safe water available at once, as there may be no source of supply immediately available at the halt, or the

duration of the halt may not be sufficient to enable water to be obtained from a well, river, or canal, and distributed to the troops. This necessity was recognized in the War Establishments, Expeditionary Force, 1914, and every infantry regiment had two water-carts, each carrying 110 gallons of water. The problem then was to clarify and sterilize 110 gallons of water by some simple method which could be easily mastered by any soldier. Sterilization was not meant to imply the complete destruction of all micro-organisms in water, but to supply a water of the same quality *qua* bacteria as that normally furnished by slow sand filtration—viz., a water free from *Bacillus coli* in 100 cubic centimetres.

The first essential was to secure a well-clarified water, because whatever process was used for sterilization, this would be much more easily accomplished if the water was clear and free from suspended matter. With this object in view, cylinders were made which fitted into the chamber containing the sponges on the water-cart; the cylinders were then packed with various clarifying materials. Experiments were made with charcoal, slag, wool, magnetic oxide of iron, and gravel and sand. Clear effluents were obtained on passing tap-water heavily contaminated with Thames mud through each material, but this soon became blocked, and to cleanse the material it had to be unpacked and thoroughly washed in a bucket with several changes of water. A sand and gravel filter was found to be the best, and with the addition of a little alum good clarification was obtained. But the removal and washing of the sand and gravel after each filling of the cart was found very laborious, and attempts to backwash with already clarified water from the cart necessitated a rather complicated arrangement of taps and pipes. I then thought of trying the effect of rapidly precipitating aluminium hydrate on the surface of thick flannelette wrapped round a perforated tin cylinder fitting into the sponge chamber. I believed that the hydrate mixed with suspended material would become deposited on the fluffy layer of the flannelette and form an efficient filtering surface, and that the body of the flannelette would give sufficient support to the filtering surface if the pressure was kept low.

The first trials were so satisfactory that I constructed a tin cylinder perforated with holes and having a cone-shaped end carrying a rubber ring, which fitted into the outlet from the sponge chamber. When the cap of the chamber was tightened up a water-tight joint was made between the tin cylinder and the outlet of the chamber. A branched pipe, with a tap, was fitted at the outlet of the chamber so that imperfectly clarified water could be run to waste, and a perforated box containing alum was placed between the tin cylinder and the cap of the chamber. The water entered by a port at the side of the chamber, passed through the alum box and then through the flannelette from *without* inwards, and ran to waste until it became clear, when by turning the tap on the branch pipe the water was directed into the body of the cart. A relief valve was placed on the chamber, as it was found that when the water contained much sus-

pended matter the pressure might rise unduly and cause distortion of the tin cylinder; water then passed between the layers of flannelette which no longer fitted accurately. Water-carts (tanks) fitted with the new clarifiers were tested at Aldershot, and though the results as regards filtration were much better than with the old sponge clarifiers, the difficulties with the candles as regards junctions and flaws still remained, and I was not satisfied that the water-carts so fitted could ever be a success on service.

The filtering surface on the reel which could be fitted into the clarifying chamber of the water-cart was too small to enable the tank to be filled with clarified water, when much suspended water was present, without changing the flannelette. Moreover, the flannelette was found to wear badly and the fluffy layer was soon destroyed by repeated scrubbing of the cloth; this difficulty, however, was eventually got over by the manufacture of a special cloth, which was selected after trials with many different samples at the School of Sanitation, Aldershot.

I then designed a large reel which, when wrapped with the prepared cloth, had a surface sufficiently large to filter fifty gallons of flood water

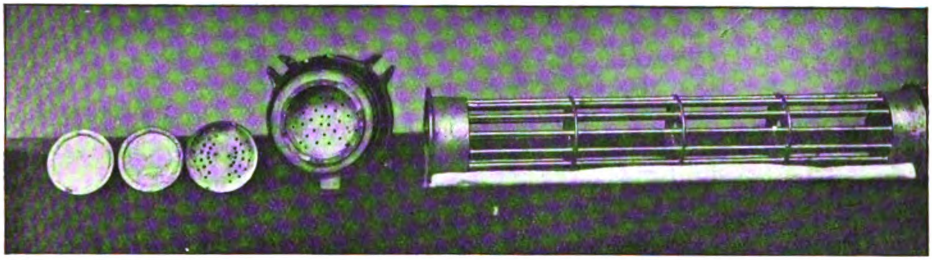

Fig. 1.

from the Thames. The reel consisted of a number of steel rods fitted into two circular plates, one of which was notched at the edge to allow the incoming water to pass to the outside of the cloth on the reel, and to the other was fixed a conical exit tube carrying a rubber ring. The rods were also supported by three plates hollowed in the centre. The reel fitted closely into a specially constructed cylinder placed at the side of the tank. The cap of the cylinder had on the inside a projecting chamber with large apertures at the sides for the entrance of the water to be clarified, at the bottom of the chamber were numerous large holes through which water passed into a box closed by a lid, having a bayonet catch, the lid of the box was perforated with holes and had a bar across the centre; in the interior of the box were two rings of metal gauze between which the alum was placed, the object of the gauze rings was to get the alum gradually dissolved and to prevent it being washed away by the first rush of incoming water (fig. 1). The water to be treated entered by a pipe at the side and close to the head of the cylinder, and the total area of the apertures in the box attached to the cap was supposed to be slightly greater than the area

of the pipe, so that a free flow of water could be obtained. When the reel was placed in the chamber and the lid screwed up tight, the pressure of the projecting chamber on the reel made a water-tight joint at the exit of the chamber. The ridge on the lid of the box attached to the head of the cylinder rested on the head of the reel, and a space was left between the box and reel for the water issuing from the holes in the box. To the exit of the cylinder was attached a branched pipe; one branch was closed by a screw cap and the other, on which was a tap, passed to the body of the tank of the cart. On the cylinder was fixed a relief valve, set at fifteen pounds. The general arrangement of the clarifier is shown diagrammatically in fig. 2. At first a semi-rotatory pump was employed to pump water from the source through the clarifier; but it was found that when the water contained grit the blades wore down rapidly and the pump was soon

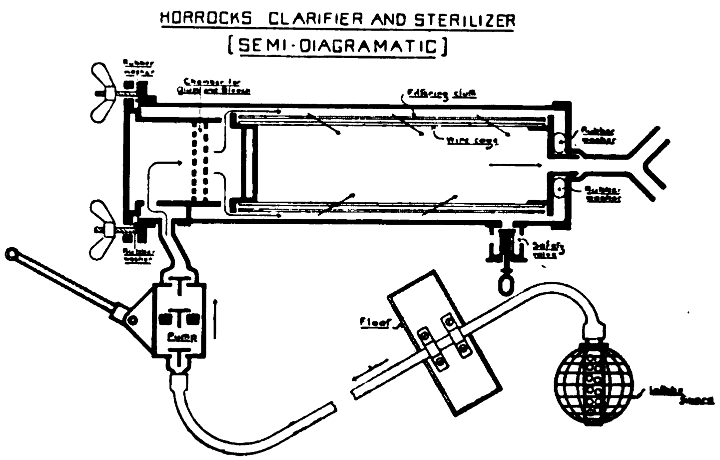

FIG. 2.

put out of action. The Carriage Factory at Woolwich then constructed a new pump, which is the one in use at the present time.

In order to secure rapid precipitation of aluminium hydrate on the surface of the cloth wrapped round the reel, five teaspoonfuls of alum, representing about three grains per gallon, were placed in the box attached to the head of the cylinder and water was pumped slowly until the cylinder was filled, and the cap being removed from the branch pipe, pumping was continued until the issuing water was quite clear; this usually occurred after the passage of a few gallons of water, which could be collected in a bucket and returned to the source if necessary. The cap was then replaced on the branch pipe and, the tap being turned on the other branch, clear water was pumped into the body of the cart.

The aluminium hydrate did not form well in some waters which were acid or deficient in alkalinity. When dried sodium carbonate was added to the alum good results were usually obtained. F. E. Daniels [2] has shown

recently that when using aluminium sulphate and sodium carbonate the maximum precipitation occurs within the zone whose limits of hydrogen-ion concentrations are pH_6 to pH_7. Solution of the floc commences at about pH 6·8 and is complete at pH 10·5. Calcium aluminates are less soluble than sodium aluminates, and the maximum precipitate is formed at a hydrogen-ion concentration of about pH 7, and solution commences before pH 8·3 is reached, at which point phenolphthalein changes from colourless to pink. A pink colour with phenolphthalein shows that the water is sufficiently alkaline to dissolve part of the aluminium hydroxide, and more so in the case of sodium carbonate than when lime is used.

Bayliss [3] has studied flocculation phenomena with the aid of the microscope, and finds there is a great danger of over-coagulation, which may be responsible for the passage of coagulated material through filters. There is a great difference between the appearance of coagulated material which is retained by a filter and that which passes readily through the beds. Suspended matter adds toughness to the floc. Alum should be rapidly mixed with the water to be filtered.

A few water-carts were fitted with these large clarifiers; better results were obtained and the candles were not so often blocked; but given the rush and excitement of active service it seemed likely that the old troubles would recur; clarification might not be complete, candles might not be properly screwed up, and flaws indistinguishable to the naked eye might be present in the filtering substance. A reasonably well-clarified water, free from gross suspended matter, would doubtless be obtained on service, but to ensure sterilization I felt that some simple process must take the place of the filter candles.

Of all the processes suggested for the sterilization of water, the use of chlorine derived from chloride of lime seemed to me the simplest.

But even as late as 1912 chlorination was not regarded with favour by military sanitarians, except for small bodies of men and in exceptional circumstances. As a routine method for general use in the field the application of heat on the heat-exchange principle seemed to find most favour. At the International Medical Congress, held in London in August, 1913, both the Austrian and the German medical officers spoke in favour of machines designed on the heat-exchange principle. I advocated chlorination, but had few supporters.

Some of the earliest work on the chlorination of water was done by German and Austrian medical officers, and I think the reason why the process fell into disfavour was because attempts were made to chlorinate imperfectly clarified water; also in many experiments pathogenic and other bacteria were added in very large numbers and it was desired to sterilize the water in five to ten minutes, which necessitated a large dose of chemical and subsequent treatment to remove the taste. It may be of interest to describe briefly some of this early work, as the results obtained were in many cases very similar to those of my first experiments, in which

samples of water were infected with very large doses of pathogenic and other bacteria. At that time I had not read the German papers.

In 1893 Traube [4] published a paper on a simple method of rendering considerable quantities of water germ-free. He stated that one part per million of free chlorine, derived from chloride of lime, acting for two hours, killed all the bacteria present in a polluted water. He added decomposing broth to Berlin tap-water, and, as only 9·1 per cent of the available chlorine was absorbed, he thought that chlorine acted more quickly on the bacteria than on the organic matter present. He removed the excess chlorine with sodium sulphite.

In 1895 Bassenge [5] wrote on the preparation of a bacteria-free drinking water by the action of chloride of lime. He said that though the action of chloride of lime as a disinfectant had been known for a long time, Traube was the first to conceive the idea of rendering drinking water free from bacteria by the action of chlorine obtained from chloride of lime. Bassenge experimented with water from the River Spree, containing 100,000 bacteria per cubic centimetre; he employed 1 in 1,000,000 of chlorine and contact periods varying from one and a half to nineteen hours; he then removed the excess chlorine with sodium sulphite and cultivated the treated water in broth and on gelatine plates. He found that ten times the amount of free chlorine used by Traube was required to sterilize the Spree water in two hours. It is to be noted that Bassenge in these experiments apparently worked with an unclarified water.

In his next experiments he added an agar growth of *Bacillus typhosus* suspended in broth to tap-water placed in a series of flasks, and again employed 1 in 1,000,000 of chlorine, allowing it to act for periods varying from one to eight hours. At the expiration of the contact time he removed the excess chlorine with calcium bisulphite and cultivated the water in broth and on gelatine plates. In every experiment many thousands of typhoid bacilli developed in the cultures. In other experiments he added an agar growth of *B. typhosus* to Spree water, Berlin tap-water, and to water from the Berlin streets; about 2,500,000 typhoid bacilli were counted in the infected water. As a result of his work he stated that about 1 in 100,000 of chlorine was required to sterilize in two hours waters heavily infected with pathogenic bacilli. The excess chlorine could be removed with calcium bisulphite; the water then had no taste and could be drunk without any prejudicial effect on the body. He recommended that waters containing much suspended matter should be filtered, as less chloride of lime would be required.

In 1895, also, Lode [6] made a detailed investigation on the Traube process for rendering a water germ-free. He employed cultures of *Bacillus coli communis*, *B. typhosus*, *Spirochæta choleræ asiaticæ* and anthrax spores. The bacteria were grown on agar at 37° C. for twenty-four hours, and the growth was mixed with sterile water and then filtered through sterile linen cloth in order to remove all large particles. Measured quantities of the

filtrate were then added to the various samples of water by means of a sterile pipette. The chloride of lime solution was made in distilled water, so as to avoid the action of organic matter on the available chlorine.

In the *B. coli* experiments he added the culture to sterile distilled water, and the control plates showed *B. coli* to be present in amounts varying from 6,000 to 55,850 per cubic centimetre. The contact time varied from two minutes to two hours. As a result of these experiments, Lode concluded that *B. coli* was not killed as a rule in two hours by the action of 1 in 1,000,000 of chlorine, but typhoid bacilli and the vibrios of Asiatic cholera were destroyed after forty minutes' and twenty minutes' contact respectively. Anthrax spores were only killed after one hour by 15,000 parts per million of chlorine.

Lode recognized the artificial nature of his experiments, and stated that the really practical tests were those made with waters containing organic matter such as soldiers would have to use on service. He then worked with a number of waters so polluted as to be about on the limit of potability. In order to determine the amount of organic matter present he took a series of flasks, each containing a litre of water, and added the chloride of lime emulsion in gradually increasing doses; the first flask received 0·0019 gramme, the second 0·0029, the third 0·0049, and so on. At the end of ten minutes he considered the action of chlorine on organic matter would have taken place, then added potassium iodide and starch; the first flask showing a deep blue colour he supposed to have sufficient free chlorine present to kill the bacteria. He found that the amount of chlorine required varied directly with the organic matter present, and in the case of these very polluted waters eight parts per million of free chlorine were required to destroy the bacteria in thirty minutes; thirty parts per million were required to sterilize these waters in ten minutes.

Lode said it was essential to rub up the chloride of lime in a little water so as to make a fine emulsion; if the powder was added directly to a water there was a loss of nearly eight per cent of chlorine, as the large particles gave up their chlorine very slowly. A very active chlorine was obtained by adding an acid, such as citric acid, to chloride of lime emulsion, but the mixture had to be added to the water at once, as there was a very rapid loss of chlorine. For instance, an emulsion estimated to contain forty milligrammes of Cl gave, after the addition of 0·59 gramme of citric acid, when titrated at once, 37·7 milligrammes of chlorine, but after eight minutes only 3·55 milligrammes of chlorine.

Lode's experiments were full of interest, but he, as well as the previous workers, seemed to have been actuated by the desire to obtain sterilization of unfiltered water in a short time by means of large doses of chloride of lime which required the subsequent addition of a sulphite to remove the excess chlorine.

Schumburg [7] in 1903 wrote that chemical disinfection of water could not be relied upon in all cases. A short contact up to three-quarters of an

hour was not sufficient. He worked with bromine, and in a previous paper, written in 1897, he stated that 0·6 gramme of bromine per litre would sterilize a water in five minutes; in 1903, however, he qualified this statement and said that as a rule 0·8 gramme of bromine per litre would be required to kill typhoid bacilli. For general use he recommended sterilization by heat or ozone. On expeditions, when marching was rapid and little rest could be obtained, and sterilization by heat or ozone was impracticable, he thought chemicals might be used, especially bromine. At Professor Notter's suggestion I made experiments with bromine in 1898, and found that 0·6 gramme of bromine per litre was not sufficient to kill typhoid bacilli in five minutes. If suspended matter was present, it was necessary to go on adding bromine until a yellow colour was maintained for five minutes. The process was tried in the Sudan Campaign of 1898; weighed quantities of bromine were supplied in glass capsules and tablets of sodium sulphite to remove the excess bromine were provided. Careful instructions for use were sent, but the results were not satisfactory. Considerable difficulty was experienced in regard to the carriage of the glass capsules, and the success of the process depended on the action of the individual soldier, who could not be relied upon to dose the water he intended to drink. There was also a prejudice against drinking water containing sodium bromide. These objections did not apply to chloride of lime, but in spite of the experiments already detailed military opinion, both in England and abroad, was against the use, except in special circumstances, of chemicals for the sterilization of drinking water.

In 1903 Nessfield [8], of the Indian Medical Service, made a number of experiments with chlorine gas, and found that 0·125 gramme of chlorine per litre sterilized a tap-water heavily contaminated with *B. typhosus*, *B. coli* and with *B. dysenteriæ* of Shiga in five minutes. The water was then dechlorinated with sodium sulphite. Nessfield thought the gas might be liquefied and stored in lead-lined iron vessels, having a jet with a very fine capillary canal. The cylinder was to be placed in the water to be sterilized and the chlorine allowed to bubble out for ten or fifteen minutes; the water would then be quite safe and had only to be rendered tasteless by the addition of sodium sulphite made into a cake or tablet. Nessfield thought the process might be used on the large scale for the service water-cart. Military sanitarians regarded Nessfield's proposals as "fantastic," but though the process as described in his paper was not a practical proposition on field service, he certainly deserves the credit of being the first to suggest the use of chlorine gas for the sterilization of water.

In 1910 Major Darnall, of the Medical Corps, U.S.A., designed an apparatus for the sterilization of water by means of chlorine gas, and a model was erected at Fort Meyer, Va. The water was treated with alum and then dosed with 0·5 to 1 part per million of chlorine. Good results were obtained and the water had no objectionable taste or odour. Darnall was the first to put the employment of chlorine gas on a practical footing,

and his apparatus was demonstrated before the International Congress for Hygiene and Dermography held in Philadelphia in 1912.

Nessfield also suggested the use of a tablet containing 1½ grains of bleaching powder and a ½ grain of sodium bicarbonate for the sterilization of the contents of the soldier's water-bottle; he stated that such a tablet would sterilize a pint of water in five minutes, though it would be as well to allow the action to continue for ten minutes. The water was then rendered tasteless by the action of 1½ grains of sodium sulphite. Colonel Firth found sterilization was not effected even when the tablet was allowed to act for one hour.

My first experiments were made in 1898, in the School at Netley, with the tap-water, which I contaminated with broth cultures of *B. typhosus* and *B. coli* and treated with varying doses of chloride of lime, usually 0·2 gramme per litre, and a contact period of five minutes, as suggested by Austrian medical officers. The results on the whole were not satisfactory; the contaminating doses of bacteria were large and the contact period was too short. In 1910 I took up the work again in the Royal Army Medical College, London. I contaminated the water as before with broth cultures of *B. typhosus* and *B. coli*, but used 1 in 1,000,000 of chlorine and allowed a contact period of half an hour. The results were better, but sometimes growths appeared in the treated water when it was cultured in broth. I thought possibly some of the chlorine was absorbed by the broth and that probably clumps of bacteria were present and the chlorine did not reach the interior of the small masses. I then made use of young agar cultures, which were very finely emulsified so as to remove all clumps. The results on the whole were good, but occasionally sterilization was not obtained. The contaminating doses of cultures were very large and not likely to be found in natural waters polluted in the ordinary way. I realized that these experiments were very artificial and that the only real practical tests were those made with contaminated waters such as the soldier would be likely to meet on service. Examination of contaminated crude waters from many sources and carried out over a series of years had shown that the *B. coli* content rarely exceeded 1,000 per cubic centimetre, and was commonly found in the range between 10 to 100 per cubic centimetre. But these waters generally contained suspended matter and dissolved impurities, especially when obtained from canals or rivers, and absorbed a good deal of chlorine, and in the *crude* state I found, like the German workers, that one part per million of active chlorine acting for half an hour was often insufficient to render 100 cubic centimetres of these waters free of *B. coli*, the standard at which I was aiming.

I then determined to try the effect of one in a million dilution of chlorine acting for half an hour on well clarified waters from various sources such as troops would be likely to use on service. With this object in view, a water-cart provided with two large clarifiers was taken to the upper reaches of the Thames, to the Regent's Park canal, the ponds at Hampstead,

and the canal at Aldershot. The *B. coli* content of these waters varied enormously, but in none was the microbe ever found in greater quantity than 1,000 per cubic centimetre, and clarification alone probably removed eighty per cent of the bacteria. These waters, when well clarified, were rendered free from *B. coli* in 100 cubic centimetres by one in a million chlorine acting for half an hour.

The water-cart was then taken to various ponds in farmyards, and attempts were made to treat the water, which contained much suspended matter and was often markedly contaminated with manurial matter. Clarification was difficult, and the cloth had frequently to be changed on the clarifier before the cart could be filled with clean water. As was expected, one in a million of chlorine often failed to sterilize the water owing to the rapid absorption of chlorine; the clarified water had to be frequently tested with potassium iodide and starch and more chlorine added until a blue colour permanent for half an hour was obtained, when sterilization was usually effected. Great stress was not laid on the sterilization of these pond waters, as they are little likely to be used by troops on service, and then only by small bodies of men and for short periods. Great importance was attached to the results obtained with river and canal waters, as it was felt that if our troops took part in a European war these sources of supply might have to be used and would probably present the greatest difficulties as regards clarification and sterilization. Experiments made with well waters in England showed that deep well waters were, as a rule, sterilized by one part per million of chlorine. Shallow wells in constant use did not present any difficulties, but if disused for some time there might be considerable growth of vegetable material which slowly absorbed large quantities of chlorine.

My experimental work seemed to indicate that one part per million of free chlorine acting for half an hour would render a well-clarified river water, canal water or deep well water free from *B. coli* in 100 cubic centimetres.

Support for this belief was obtained from an inspection, which I made in 1911, of the plant designed for the chlorination of a part of the Reading water supply [9]. Water from the River Kennet was passed through pre-filters of polarite and sand, and then treated with a solution of chloride of lime, so that the water received one in a million of available chlorine. The treated water passed to a cylindrical reservoir where, after a contact of thirty minutes, it was filtered through two beds of silica and one of prepared charcoal. The filtered and treated water did not contain *B. coli* in 100 cubic centimetres, and had no appreciable taste.

The history of the epidemic of typhoid fever at Lincoln [10] in 1904-5 was also important from this point of view. Klein discovered what he regarded as the *B. typhosus* in the River Witham, the water from which passed directly on to filter beds. The filtered water was pumped up to two

reservoirs, and afterwards distributed by gravity to the consumers. Houston disinfected the filter beds, reservoirs and mains with a strong solution of chloros, and then treated the water, after filtration, with 1 in 100,000 of chloros (one in a million of chlorine). *During a period of two months seventy-seven per cent of the samples collected in the area of supply showed no B. coli in* 100 *cubic centimetres, and no further cases of typhoid fever occurred.* The chloros was then discontinued.

The question of taste remained to be considered; this seemed to depend on several factors, but it was usually found that when the unabsorbed chlorine did not exceed 0·25 part per million the taste of chlorine was generally inappreciable; 0·5 part per million gave a distinct taste. The excess chlorine could be easily removed by treatment with sodium or calcium sulphite, as in the German experiments, but the addition of a third chemical seriously complicated the process and was most undesirable if it could be avoided. It was noticed that the most unpleasant taste (Houston's iodoform taste) often developed in the purest waters, such as well waters.

A test was plainly required which would determine the smallest amount of chlorine required to sterilize any particular sample of water. Lode had already suggested such a test, but not in a form suitable for use by the ordinary water-cart personnel. Later, after the outbreak of war, with the help of Colonel Lelean and the chemists doing duty at the Royal Army Medical College, I worked out a simple form of test which was widely used in France. Up to 1914, however, instructions were given to use one in a million chlorine and to allow as long an interval as possible between chlorination and consumption of the water.

It was found that after an hour or two, the excess chlorine usually disappeared. Moreover, unless the water was going to be used immediately after chlorination, there was an advantage from the point of view of sterilization in having a slight excess of chlorine, as on service it was not easy to keep water-carts meticulously clean.

It was intended to test the new procedure on the manœuvres which were to be held in September, 1914; the chloride of lime was to be issued in small four-ounce tins, each of which would contain a small spoon (holding twenty-three grains) fixed to the lid, so that one spoonful of the chloride of lime, containing on an average thirty per cent of available chlorine when added to 100 gallons of water in the body of the water-cart, represented one part of chlorine per million of water. If we had found that the taste of chlorine was so marked as to prejudice the use of the water then sodium sulphite, or sodium hyposulphite, as it is more stable, would have been employed to remove the taste.

Unfortunately war was declared and the manœuvres were abandoned. We had then to make a momentous decision. The Expeditionary Force was equipped with the old pattern water-carts, which were stored at Woolwich, and must take the field with them. The question was, should the manufacture of these carts, the imperfections of which were now well

known, be continued, or should we adopt as the policy for water purification clarification by alum and chlorination of the clarified effluent. I unhesitatingly decided in favour of chlorination, and recommended that all new units should be equipped with a water-cart having a circular tank to which two large clarifiers were attached, one on each side. The chloride of lime to be issued as was intended for the manœuvres, i.e., in four-ounce tins, each having a spoon, holding twenty-three grains, fastened to the lid. These recommendations were approved and the manufacture of the new water-carts was taken in hand by numerous firms, to whom the Carriage Factory at Woolwich issued the necessary specifications and drawings.

Instructions were also issued to the medical officers doing duty with the units of the Expeditionary Force to chlorinate the water after passage through the sponge clarifier, and not to rely on the candles for the sterilization of the supply.

At my first visit to France, in the last week of October, 1914, I found in certain divisions that the water which had passed through the sponge clarifier was very imperfectly filtered, and more than one part of chlorine per million was required to destroy the *B. coli* present.

In other divisions, where the water supply was mainly derived from wells and contained little suspended matter, chlorination seemed to be proceeding satisfactorily, and there were few complaints about the taste, except when tea was made.

On my return to London I took up the question of a test to determine the amount of chlorine required by waters containing varying amounts of dissolved and suspended impurities. Lode had already, in 1895, suggested such a test; he added gradually increasing quantities of chloride of lime emulsion, containing 0·0019 gramme, 0·0029 gramme, 0·0049 gramme, etc., of chlorine to a series of flasks, each containing a litre of the water to be tested, and at the end of ten minutes added potassium iodide and starch. The flask which still showed a blue colour was supposed to indicate the parts per million of chlorine required.

In September, 1914, the late Sir G. Sims Woodhead published in the *Lancet* a description of a similar test. He suggested that a number of enamelled iron pint mugs, holding eighteen ounces or 500 cubic centimetres, should be taken. One of the mugs was to be rinsed with the water to be tested, leaving a few drops in which two grammes of chloride of lime, contained in a glass capsule, were to be emulsified; the cup was then filled with eighteen ounces of water and the whole thoroughly mixed. Then eighteen ounces of the water to be tested were poured into each of four other mugs, and one charge of the chloride of lime emulsion was added by means of a special pipette (holding 0·15 cubic centimetre) to the first mug, two charges were added to the second mug, three to the third mug, and four to the fourth mug. After fifteen minutes potassium iodide and starch solution, made in a clean mug with tablets provided, was added to each of the mugs. If a blue colour appeared in the first of the four mugs, one-

half of the contents of the mug containing the chloride of lime emulsion was added to the water in the water-cart; if the first mug showed no colour and the second was blue, then the whole of the chloride of lime emulsion was placed in the water-cart; if the second mug showed no colour and the third was blue, then a second two grammes was dissolved in eighteen ounces of water, and half of this, as well as the first two grammes, was added to the cart, and so on.

Sims Woodhead stated that he realized the difficulty of getting this test carried out in the field, but at his suggestion I sent to France a number of test-boxes, containing the special pipette, capsules of chloride of lime, and tablets of potassium iodide and starch, and also a copy of his instructions. But no demands were made for the case.

The troops were provided with four-ounce tins of chloride of lime containing special spoons, and some means of using these was required.

A number of samples of chloride of lime then being supplied to the troops in the four-ounce tins was analysed at the Royal Army Medical College and found to contain on an average thirty-three per cent of chlorine. I then worked out that if I made an emulsion of 2 grammes of this powder in 250 cubic centimetres of water and used a pipette, each drop from which, when held vertically, represented $\frac{1}{15}$ cubic centimetre, then each drop of emulsion added to 187 cubic centimetres of the water represented one part per million of chlorine.

Now the troops had four-ounce tins of chloride of lime and a spoon holding twenty-three grains. Consequently one spoonful of chloride of lime, containing thirty-three per cent of chlorine, when added to 110 gallons, the content of the water tank, also equalled one part per million nearly.

A small box was then made containing six small white cups, each holding 187 cubic centimetres, and one larger blue cup holding 250 cubic centimetres. As the test reagent, Colonel Lelean and the chemists at the College found that zinc iodide and starch was preferable to potassium iodide and starch; it was more delicate and had better keeping qualities. An emulsion of the chloride of lime available was made by working up 2 grammes in a little of the clarified water and then diluting up to 250 cubic centimetres; one drop of this emulsion was added by means of the pipette held vertically to the first 187 cubic centimetre cup, two drops were added to the second cup, three drops to the third, and so on. The first cup which showed a permanent blue colour on the addition of zinc iodide and starch was regarded as indicating the number of spoonfuls of chloride of lime which should be added to the water in the cart. The chemists pointed out that it was better to add the test reagent after the thirty minutes contact, but in the original test I added the test reagent immediately after the drops of chloride of lime emulsion had been well mixed with the 187 cubic centimetres of water, the object being to obtain an early indication of the amount of chloride of lime required in case there

should be an urgent demand for water. When waters were heavily polluted I found there was a very rapid absorption of chlorine in the first few minutes. If the chloride of lime in the tin did not contain thirty-three per cent of chlorine, then the drops of emulsion in 187 cubic centimetres of water and the standard spoonful added to the contents of the cart would not represent one part per million of free chlorine. But there was always a constant relation between the drop of emulsion from the pipette and the spoonful of chloride of lime, when used in the manner described, and if the chloride of lime was weaker in chlorine, then more drops of emulsion would be required to get a permanent blue colour, and more spoonfuls of chloride of lime would have to be added to the water in the tank.

The test-case containing six small cups, one larger cup, pipettes, test solution, etc., packed in a small wooden box, was then issued to units in France and to other theatres of war and was in use until the Armistice (fig. 3).

Fig. 3.

MM. Gascard and Guy Laroche [12] suggested the following test for use in the French army. Into five glasses, numbered 1 to 5, each containing 100 grammes of the water to be tested, pour with a pipette held vertically, one, two, three, four, five drops of extract of Javel, diluted 1 in 200; mix thoroughly, wait twenty minutes, then add to each glass a crystal of potassium iodide and five to ten drops of starch solution. Several of the cups will be coloured blue. The lowest number of these indicates the number of drops of pure extract of Javel which must be used, with the same pipette, for twenty litres of the water to be sterilized.

In 1915 Massy compared the Horrocks test with the Gascard-Guy Laroche test. In 26 experiments 13 agreed, in 3 the Horrocks test was slightly superior, and in 10 the G.G.L. gave a higher result.

For small units, not provided with a water-cart, I recommended the issue of a clarifier, similar to those attached to the water-cart, a portable pump with stand and sections of hose-pipe, packed in a wooden box (fig. 4).

Two fifty-gallon canvas tanks, having pipes at the bottom of one of the sides, by means of which water bottles could be filled, were also supplied later on (fig. 5). A test-case was also issued to these units.

In June, 1915, when reports reached the War Office that the Germans had poisoned wells in German South-West Africa, in order to hold up pursuing troops, I was asked to take up the problem of the removal of

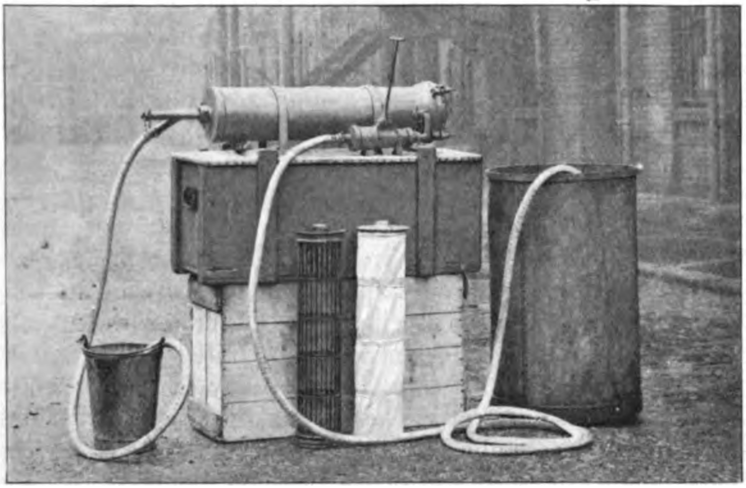

FIG. 4.

FIG. 5.

poisons from water, as it was thought that the Germans might resort to similar tactics in France. I consulted Professor H. B. Baker, F.R.S., who devised certain chemical processes for the removal of the poisons which he thought might be added to water. Full details of these processes and of the motor machines and barges which were constructed to deal with poisoned waters are given in Vol. I, "Hygiene of the War."

The so-called "depoisoning" plants, both on motors and in barges, could also be used for the purification of water by chlorination when they were not required for the removal of poisons. But owing to the filters being used after the poisons had been precipitated in two tanks, the chlorination process was different. The "raw" water was treated with chloride of lime in the first tank, the amount of chlorine required being determined by the test-box, and the suspended matter flocculated by alum in the second tank, the precipitated matter being removed by filtration through the sand filter. Dechlorination was not attempted at first on the motor plant, but it was found in France that this could be easily done by means of two five-gallon petrol drums, placed above the sand filter, and discharging the calculated amount of dechlorinating agent into the effluent channel. By this plant 400 gallons of safe water were delivered per hour.

In June, 1915, the Commander-in-Chief in France forwarded to the War Office a request for the provision of motor and barge water purification plant, which would be required in the case of an advance in Belgium. The plant already described, and a motor water purification plant, the chlor-"permutit," designed by the United Water Softeners Co., which I had tested in 1913 at the Royal Army Medical College, were considered suitable, and a Water Depot was opened at Brentford, where the machines were assembled and tested, and two water companies were formed. A full description of the various plants is given in Vol. I, "Hygiene of the War." For duty with the water companies young and able chemists were commissioned, and after a short preliminary course of instruction in the bacteriology of water supplies at the Royal Army Medical College, carried out hundreds of experiments on the chlorination of the very polluted water available at Montgomery Wharf, Brentford, and of the Thames at Richmond. When the results of the chemical and bacteriological work were tabulated it was found that an estimation of the excess chlorine did not always give an indication of the efficiency of the treatment. This is illustrated by the following figures obtained from a test at Richmond with Thames water:—

Initial chlorine	Excess chlorine	Chlorine absorbed
3·75	3·1	0·65
2·5	2·0	0·5
1·25	0·6	0·65
0·625	0·6	0·025

The excess chlorine, 0·6, was the same when 1·25 parts per million and 0·625 parts per million were added, but the latter was not sterile. At Brentford it was repeatedly observed that if less than 0·5 part per million was absorbed sterility was not obtained. After a little practice with the test-case it was quite easy to determine by the colours whether the requisite absorption had taken place. A water which, after thirty minutes contact with one part per million of chlorine, still showed a marked blue colour was regarded with suspicion, and a bacteriological examination

almost invariably showed *B. coli* in 100 cubic centimetres. Working with the motor plant on an unknown water it was found advisable to treat the water with a large initial dose, 5 parts per million, and then cut down the dose in accordance with the results of bacteriological examinations. There is no objection to such treatment; nay, in accordance with Sir Alexander Houston's [13] experiments, there seems to be a distinct advantage, as he has found that when dechlorination follows a large initial dose of chlorine there is less likelihood of developing an objectionable taste in the water.

The more we worked at chlorination, whether effected by gas or choride of lime, the more we were convinced that there were many factors in the chlorination process which we did not understand. When using the motor plants we felt we were on fairly safe ground, as we could always over-chlorinate and then dechlorinate to any point we desired.

Working with the water-carts the position was more difficult, and we instructed our classes at the College to be very suspicious of any water which did not absorb 0·5 part per million of chlorine and to allow as long a time as possible for the chlorine to act. They were never to cut down the chlorine, because the excess seemed to be large, until the results had been checked by a bacteriological test. No doubt in certain cases this action rendered the Medical Service unpopular, but English troops soon learned to drink chlorinated water and did not complain much except when it spoiled their tea. M. Massy stated that English troops drank a chlorinated water that French troops refused to touch.

In most of the theatres of war the water supplies were so polluted that the absorption of chlorine rarely fell below 0·5 part per million. The waters which gave rise to the greatest anxiety were those derived from wells; by percolation of the water through the earth surrounding the wells the suspended matter was largely removed, but *B. coli* was still often found in from 0·1 cubic centimetre to 0·01 cubic centimetre. These waters sometimes absorbed very little chlorine and a most unpleasant taste might result.

If the taste resulting from the use of chlorine in the amounts indicated by the test-box had proved so objectionable as to make soldiers resort to unauthorized sources of supply, I was prepared to recommend in the case of the water-carts excess chlorination, that is, one or two parts per million above the amount indicated by the test, and then dechlorination by means of a sulphite. Fortunately the necessity for this complication of the process did not arise.

When the United Water Softeners Co. had drawn our attention to the Wallace Tiernan apparatus for controlling the dosage of chlorine gas, and we employed this agent on our motor plants, we all noticed that the taste of the treated water was much less unpleasant than when chloride of lime was used. The reason for this was not apparent. It might be explained by better mixing and more accurate dosage, as suggested by Race [14], but

of the fact there was no doubt. We at once went into the question of using chlorine gas with the water-carts, but the cost of the Wallace Tiernan apparatus was so great as to preclude its use on any machine delivering less than 800 to 1,200 gallons per hour. Moreover, there was a military objection to taking large numbers of gas cylinders into the front area. The employment of liquid chlorine in glass capsules was suggested, but in view of our previous experience with bromine packed in a similar manner, I was not prepared, in the stress of a great war, to adopt the suggestion. Questions of manufacture, packing, quantities required, and space taken up on the cart by a reasonable supply, etc., all required to be worked out, for which we had not the time.

Chlorine gas has been considered by many experimenters to be a more efficient sterilizing agent than bleaching powder. But this is not really the case when the available chlorine is properly extracted from bleaching powder. Diénert has shown that in the ordinary process of extraction only about eighty per cent of the available chlorine is obtained from chloride of lime. Hale also found that large quantities of chlorine were lost in the process of extraction, but when this was rectified and the amount of chlorine from liquid chlorine and from bleach was identical, then the reduction of *B. coli* was about ninety-three per cent in each case.

Chlorine water contained in ampoules has been recommended by Marshall for the sterilization of water. He says that when the materials used are pure the solution is stable, but in our experiments we did not find this to be the case, and Race states that a saturated solution of chlorine in distilled water lost over fifty per cent of its available chlorine when stored in the dark for five days at 70° F.

In Mesopotamia Captain Morison prepared from bleaching powder a standard solution containing 1·28 per cent of available chlorine; this solution was fairly stable for about ten to fourteen days.

The instability of chloride of lime, packed in tins, in a tropical climate proved a great source of trouble, especially in Mesopotamia and Palestine. We made many experiments on the best methods of packing it and obtained a certain amount of success. Captain Arthur also devoted considerable time to experimental work with a combination of bromine and lime, which did not break up at temperatures obtaining in tropical climates. Before we had come to any definite conclusion as to the employment of this substance the Armistice was declared, and very soon afterwards the water depot was disbanded and our work came to an end. It is satisfactory to learn that chloride of lime has now been stabilized by the addition of lime, and the drawback to its use in tropical climates has been removed. There is now no reason why chlorination of water supplies should not be used wherever our troops may be called upon to fight. In its simplest form chlorination requires merely a clarifier, a pump, two canvas tanks, a test-box and a supply of alum and stable chloride of lime. Even the clarifier might be omitted if time permitted the use of clarification by alum in one of the

tanks. I think the experiences of the late war have shown that chlorination was the correct policy, and that purification of water supplies on service by chemical means has probably come to stay. But there are still many lacunæ in our knowledge. During the war, as I have said, one often feared that the production of an unpleasant taste might prejudice the military mind against chlorination, and it must be admitted that we know very little on this important subject, which would well repay a thorough and prolonged investigation. Also we should know why with some waters, when apparently plenty of chlorine is present, we must have a certain mass action before sterility can be obtained.

Diénert [15] states that two factors influence the destruction of *B. coli* in water: (1) organic matter; (2) the time of sojourn of the germs in water. Organic matter in solution and in suspension absorbs chlorine in the same way; nitrogenous organic matter acts with the greatest intensity, non-nitrogenous matter has the slightest action. Ammonia and urea which do not act on permanganate have a sensible action on hypochlorite. The disappearance of chlorine under the influence of organic matter depends on five factors: (1) the nature of the organic matter; (2) the quantity of organic matter; (3) the time of contact; (4) the concentration of hypochlorite; and (5) the temperature. Chlorine is absorbed according to a logarithmic law. As much chlorine is absorbed in the first five minutes as in the three hours following the first quarter of an hour of contact. The chlorine required is determined in the usual way, by adding standard drops of hypochlorite solution to a series of flasks, each containing 500 cubic centimetres of water. After the time of contact potassium iodide and starch are added, and the first flask showing a blue colour indicates the dose. If the time of contact is short, say half an hour, then 0·2 milligramme of free chlorine is added to the dose determined. In Paris the contact time is three hours. According to Diénert the dose determined is sufficient to kill *B. coli* in ordinary cases, but in times of flood more chlorine is required. He states that more chlorine is required to kill *B. coli* freshly added from an agar slope than when the same germs have been eight days in water. In the same way he thinks the germs recently added in flood time are more difficult to kill than when they have been some time in water. In these circumstances he adds an extra 0·3 milligramme to 0·5 milligramme when the time of contact is short.

The bactericidal action of chlorine was at one time considered to be due to nascent oxygen, but Race's experiments, made in 1915-16-17, seem difficult of explanation on the nascent oxygen hypothesis. He states that when a solution of chlorine or a hypochlorite is added to water the general reactions are of three types: (1) oxidation of organic matter; (2) direct chlorination of organic matter; (3) bactericidal action. Reaction (1) can be adequately explained by the nascent oxygen hypothesis, and probably determines the dosage required for effective sterilization. Very little information is available regarding reaction (2), but there is little doubt that direct chlorination does occur. As regards reaction (3), it is suggested that

chlorine and chlorine compounds exert a direct toxic action on micro-organisms. Cross and Bevan's work on the combination of chloramines with nitrogenous molecules is thought to support the hypothesis that a portion of the chlorine or chlorine compound may penetrate the membrane of the microbe and produce changes which result in the death of the organism.

In this connexion the experiments of Langer are of interest. Langer says the disinfecting action of chloride of lime depends on the concentration of the available chlorine; it does not depend on the *duration* of the action of the free chlorine, viz., increasing the time of action does not diminish the necessary limit of concentration. The reaction between chloride of lime and bacteria takes place very quickly, and this process is not an oxidation but an absorption of chlorine. In his first experiment a growth of *B. coli* on an agar slope was added to one litre of pipe-water, so that one cubic centimetre of the water contained 100,000 bacteria, and one in a million of chlorine was added. After one, two, three and five minutes a 10 cubic centimetre specimen was taken, neutralized with sodium sulphite, and the number of bacteria determined. The following results were obtained :—

Time of taking specimen	Number of bacteria
Before the addition of chlorine ..	100,000
After 1 minute	370
,, 2 minutes	510
,, 3 ,, ...	310
,, 5 ,, ...	340

Very similar results were obtained when experimenting with water bacteria.

Langer shows that the disinfecting action of chlorine is increased if it is added fractionally instead of all at once. He believes that bacteria vary in their resistance to the action of chlorine. When *Staphylococcus aureus* was added to a water he found the disinfection value of a known concentration to be dependent on the time of action.

Harold and Ward [17], on the strength of some interesting experiments with broth and agar cultures of microbes, arrive at the conclusion that "the anomalous results met with in practice are attributable to inhibition, and that the sterilization by chlorine and hypochlorites of waters with a high colloid content is unreliable if only an examination for the presence of free chlorine in excess of natural deviation is relied on." They say that inhibition is induced by broth, excess of micro-organisms, animal and vegetable pollution, and, when it occurs, an extremely large dose of chlorine is required to effect sterility. They are of opinion that the addition of chlorine gas to water containing ammonia is conducive to the formation of chloramines or possibly other chlorine ammonia compounds. They think that the organisms or colloids in intimate contact with them take up ammonia first, and on the appearance of chlorine gas, chloramine or other chlorine ammonia compounds are produced *in situ* and exercise their maximum effect. They find chlorine gas and ammonia three times more effective as a sterilizing

agent than chloride of lime, and in addition a palatable water is produced. Their experiments did not show that alkaline hypochlorites in the presence of ammonia had an increased sterilizing effect.

According to Race, a chloramine plant is in use at Ottawa, and dilute solutions of bleach and ammonia are run from separate tanks into a common feed-box, from which the water is carried by a water injector and discharged into the suction well. In his experiments Race found 0·1 part per million of ammonia, plus 0·2 part per million of chlorine derived from bleach, gave as good results as 0·6 part per million of chlorine obtained from bleach.

Thresh [18] gives some details of the employment of bleaching powder and ammonia at a public waterworks. Nine pounds of chloride of lime (quarter to one-third part per million of chlorine) and one pound of strong solution of ammonia are used in twenty-four hours. Generally the available chlorine is four times the quantity of ammonia, and the ammonia unites with the chlorine at the point of contact with the water. No complaints of taste of chlorine or ammonia have been received for two years. Ammonia is said to cause the retention of chlorine for a much longer time and thus prevents the multiplication of bacteria; also much less chloride of lime is used.

It is possible that inhibition may be the cause of some of the anomalous results which follow chlorination of waters containing much suspended material or dissolved organic impurities, but it does not, to my mind, quite explain the difficulty of sterilizing well clarified well-waters in the presence of an excess of chlorine. In the case of the water-carts, I thought failure to mix the chlorine thoroughly with the water might possibly explain the results in certain cases, but there must be other factors at work, as similar anomalous results were occasionally seen when the motor machines were used. In these machines the filtered water was dosed with chlorine on its way to the contact tank and mixing was thoroughly well done.

It seems necessary to have a certain minimum concentration of chlorine present in the water before any disinfecting action takes place.

With regard to the action of chlorine gas and ammonia, it is of course possible that ammonia enters into combination with the microbes, and that when the chlorine gas arrives some chlorine ammonia products fatal to the bacteria may be formed *in situ*, as claimed by Harold and Ward I hope they will repeat their experiments with polluted natural waters, and that they will use the standard process of sedimentation with alum for clarification.

The difficulties of carrying chlorine gas and ammonia for use with water-carts in the field are considerable, and to justify their use in place of chloride of lime they must show quite exceptional advantages in regard to sterilization and freedom from taste troubles.

Lothian and Ward [19] have found that water chlorinated in the ordinary unprotected tanks of the water-carts has a strong "chemist's shop" flavour, probably largely due to zinc compounds, which can be prevented by painting

the tanks with a bitumastic solution. This is a useful suggestion, as it not merely removes the cause of taste but also adds to the life of the tank.

Besides the "chemist's shop" taste, Lothian and Ward admit there is an inherent chlorination flavour for which they can offer no explanation, and which has been noticed by most workers on the chlorination problem. The taste has been supposed to be due to chloramines or similar bodies, but they doubt this explanation, as the same taste is noticed when freshly-distilled water is chlorinated in clean glass vessels. At present they think "a slight and innocuous flavour must be regarded as inevitable, even in the best protected tanks."

Sir Alexander Houston distinguishes three fairly distinct tastes, chlorinous, chemist's shop or iodoform flavour, and a third which he calls "indeterminate." If enough chlorine is added to water, say three parts per million, the taste is "frankly and solely chlorinous." The taste is unpleasant, but not so nauseating as the iodoform taste. After dechlorination the water becomes tasteless, that is so far as laboratory and, to some extent, outside experiments have gone. Permanganate does not remove the chlorinous taste and may aggravate it.

The iodoform taste is apt to be associated with minor doses of chlorine; in the main it is quite a distinct taste and can be removed by permanganate. "It seems to be produced by the action of chlorine on substances about which little is known. By filtering water through a Berkefeld filter, or by the addition of traces of phenol bodies, the water may be so modified as to react with chlorine in such a way as to produce with tolerable certainty an iodoform taste. Waters containing little oxidizable matter (e.g., well water) appear to be specially sensitive, so that it cannot be said that it is merely a question of chlorine acting on organic matters."

As regards the "indeterminate" taste, Houston says we are on very uncertain ground, as we are dealing with tastes very similar to those which occur in untreated waters. "They are not so common or so objectionable as the iodoform taste, and though some can be removed or obviated in much the same way, others are of a most intractable character."

It would seem that there are three courses open to us when dealing with an unknown water:—

(*a*) With the aid of the test-box to determine and then use the smallest quantity of chlorine which will give a slight excess after thirty minutes' contact. This course was largely followed with water-carts during the war. If less than 0·5 part per million of chlorine is absorbed, there is a possibility that sterilization may not take place, and there is always the chance when the water contains little suspended matter (e.g., well water) of developing a slight iodoform taste.

(*b*) To use chlorine gas and ammonia, as suggested by Harold and Ward. This course has apparently the advantage of more certain results as regards sterilization and a tasteless water is said to be produced. This

process should be tested on the large scale with polluted waters such as the troops might use on service. The difficulty of providing chlorine gas and ammonia for use with water-carts is considerable, but not unsurmountable. If the process survives further tests, and a sterile tasteless water is produced under active service conditions, then a great advance will have been made and questions of supply and carriage of chlorine gas and ammonia will have to be carefully studied.

(*c*) To use super-chlorination with chloride of lime and render the water distinctly chlorinous. In the case of small units the water must be dechlorinated by means of sodium sulphite or hyposulphite. This presents no difficulty, but has the disadvantage of requiring the carriage of an extra chemical. If boldly done the process ensures thorough sterilization and is not likely to be followed by any marked taste troubles. This process requires to be tested with water-carts under service conditions, and the water personnel will have to be thoroughly trained to use the alum, chloride of lime and sulphite in proper sequence.

The first course suggested has stood the acid test of a great war, and we are familiar with its limitations under service conditions. It requires very little intelligence on the part of the water personnel, makes a minimum demand on the supply services and its simplicity appeals to the military administrator.

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FURTHER INVESTIGATION INTO THE STERILIZATION OF WATER BY CHLORINE AND SOME OF ITS COMPOUNDS.

By Major C. H. H. HAROLD.

Royal Army Medical Corps.

"There is no safe method of preventing water-borne diseases except sterilization of the liquid."

—RIDEAL.

PRELIMINARY NOTE.

(*a*) Titrations represented thus : $\frac{0{\cdot}4 \quad 0{\cdot}5}{0{\cdot}8}$ indicate that two titrations have been performed. The first in two stages—the indicator, starch and KI being first added to the solution, the N/10 or N/100 thiosulphate solution is then run in until the blue colour disappears. This is called the first titration fraction and is 0·4. A few drops of 25 per cent H_2SO_4 are now added and the blue colour reappears. This is discharged by 0·5 c.c. of thiosulphate solution and is the second titration fraction.

The reading 0·8 is a total reading obtained by taking an equal volume of solution as in the preceding titration adding acid and indicator and carrying out a straight titration.

(*b*) A cart contains 110 gallons of water = 500,000 c.c. (approx.).

(*c*) Tanks used contained 11 gallons of water = 50,000 c.c. (approx.).

(*d*) A cart dose of chlorine (1 part per million) = 0·5 grm.

(*e*) A tank dose of chlorine (1 part per million) = 0·05 grm.

(*f*) Cl_2 = aqueous solution of Cl_2, unless otherwise stated.

(*g*) Equivalents of Cl_2 and NH_3 may be represented as a ratio of 1 Cl_2 to $\frac{1}{2}$ of NH_3 by weight or 2 to 1.

(*h*) A double equivalent of Cl_2 to 1 of NH_3 may also be shown as 1 equivalent of Cl_2 to $\frac{1}{2}$ an equivalent of NH_3, or as a ratio of 4 of Cl_2 to 1 of NH_3 or 1 of Cl_2 to $\frac{1}{4}$ of NH_3 by weight.

(*i*) Clarifying power—aluminium sulphate 2 parts,

and

Anhydrous sodium carbonate 1 part.

$Al_2(SO_4)_3\ 18\ H_2O + 3\ Na_2\ CO_3$.

COLONEL MELVILLE, one time Professor of Hygiene at the R.A.M. College, prefaced his introductory lecture on Water with the dictum, "Water is Water plus X." This is a terse and simple axiom, worthy of perpetuation.

In military practice, where short contact periods are customary, and rule of thumb methods at the front are necessary, too much attention may be focused on chlorination of water *per se*, taking it for granted that this is on all fours with the sterilization of X.

This state of affairs tends to arise because the underlying principles are not clearly defined, and as chlorination is a chemical action it is natural to turn to chemistry for elucidation of this phenomenon.

[1] When considering the effects of X, it has been brought to notice that nitrites and colloids require special consideration, and that chlorine and its compounds in the requisite concentrations imposed by short contact periods have not identical germicidal powers. Also that the ammonization of water with quarter to half part per million prior to exposure to chlorine

gas enhances the germicidal action of the latter, leads to the non-absorption or deviation of the sterilant, and results in the production of a good tasting water.

The previous results were obtained prior to July, 1923, but, owing to delays, did not leave the publishers' hands till June, 1924. In the interim the investigation continued, and now, October, 1924, it approaches termination.

The foregoing attracted the attention of an authority on chlorination, Race, whose work is more generally known in America. He has since visited the school and placed at our disposal records of work done on similar lines by himself and others, which have been of the greatest assistance in the crystallization of ideas regarding this subject.

As can be readily understood with individuals working at the same subject on similar lines, a certain amount of experimental overlapping is inevitable. Owing to the consideration of detail entailed, for the purpose of clarity, work of a similar nature will be commented on as occasion arises.

It is noted that the *Lancet* [2], August, 1923, extracted a complete synopsis of the experimental evidence brought forward in the first communication, requiring correction in one detail only. As this is a matter of some importance it will be dealt with at length.

When estimating the available chlorine content of a water, acid, KI and starch are normally added to the water. Standard thiosulphate solution is then run in and the amount of chlorine calculated. The amount of chlorine added to the water being known, the difference is the amount of chlorine absorbed or deviated by the water.

If, during the titration of strong solutions of bleach and ammonium hypochlorite and medium strength chlorôs solutions, acid is omitted, the initial thiosulphate reading reveals only a fraction of the total available chlorine, and on the addition of acid a second fraction appears. The sum of the two readings is the total available chlorine present. In the absence of acid the first fraction end-point is indefinite, i.e., the blue colour tends to reappear fairly quickly on standing.

[3] If, however, a very small quantity of KI and starch is used, and the titration is expeditiously carried out, a second fraction can usually be detected even in dilutions of 1 part per million of hypochlorite as shown in the previous paper [4]. An explanation of the above is given by Race.

[5] When ammonia is added to water prior to chlorination with Cl_2 solution, a second fraction usually appears on the addition of acid even in a dilution of parts per 10 million, though normally with chlorine alone no second fraction is titratable. Concurrently with the appearance of this, the germicidal activity of chlorine is enhanced.

It therefore may be assumed that a compound of chlorine and ammonia is formed from which the chlorine can be readily split off by acid.

Obviously dealing with a body in parts per 10 million, it was unsafe at

that time to hazard a definite opinion regarding its composition. Nevertheless, the fact remained, that when employing the original technique under laboratory conditions, this body appeared with unfailing regularity.

It was anticipated that this state of affairs would continue when experiments were conducted on a larger scale in relatively large quantities of water and not in flasks, i.e., water-carts and tanks, but it was soon realized that under these conditions this body did not invariably appear, or on certain occasions was produced in such infinitesimal quantities that it exercised little or no effect.

This anomaly necessitated a review of the technique in the flask experiments. It was noted that during the dosing of the flasks it was possible to shake up the water immediately after the addition of ammonia, although this could not be done until the operator had reached the end of the row when adding the chlorine. Hence for some seconds each flask contained a very dispersed solution of ammonia, in contact with a layer of more concentrated chlorine solution below. It appeared that this might permit of unusual attachments of chlorine to ammonia and that the solution of the problem might lie in adequate contact of suitable concentrations.

The next series of experiments was carried out with a two-way tube allowing streams of ammonia and chlorine solutions of known strength to gain momentary contact, after which the mixture passed into the main supply of water. This immediately proved successful. True, there was a considerable loss of available chlorine, but the germicidal activity was comparable to that obtained in the flask experiments, and the second titration fraction appeared. A very definite peculiar smell was noticed during these experiments which could be readily distinguished from chlorine.

Attempts were now made to obtain better results and minimize the loss of available chlorine. Streams of Cl_2 and NH_3 solutions were poured into water simultaneously and allowed to mix. This was a failure. Solutions were poured simultaneously down a short funnel; no improvement appeared. Chlorine water was put into a two-litre funnel with a cork in the bottom, and ammonia solution poured on top. Violent chemical action ensued resulting in great loss of Cl_2 and the formation of NH_4Cl and N_2, and the above-mentioned very definite smell became noticeable. Slightly better results were obtained by pipetting strong chlorine to the bottom of the funnel below very weak ammonia. The result being a small concentrated stratum of Cl_2 solution below and a weaker and larger stratum of ammonia above.

Every conceivable method of bringing chlorine into contact with ammonia was tried with indifferent success until the simple expedient was adopted of first pouring the ammonia into a cart or tank, counting ten, and then pouring the chlorine solution on exactly the same spot on the surface of the water. An immediate titration of the treated waters usually revealed an available chlorine content of 0·7 to 0·8 parts out of a possible one part per million and on occasions readings as high as 0·9 have been obtained.

If the plan of counting between the additions of ammonia and chlorine was not adhered to a loss of available chlorine resulted, accompanied by the evolution of N_2 and a slight cloud formation of NH_4Cl over the surface of the water.

Study of the currents set up by this method in eleven gallon glass accumulator tanks revealed that it was a matter of contact of adequate concentrations and that union was effected during diffusion of relatively strong chlorine solution through less concentrated ammonia. From now on it was felt that the investigation was no longer a pursuit of a will-o'-the-wisp second titration fraction and steady progress was made.

In the absence of horses a considerable strain and interference with routine work of our numerically small staff resulted from the demand for water-carts which had to be filled at the canal over a quarter of a mile away and hauled to the laboratories. It was found that if the dosing of the regimental water-cart, which contains baffles, was carried out at the laboratory no amount of stirring with glass rods or paddles produced adequate mixing. The sterilants tended to remain at the bottom of the cart, and were run off in concentrated solution when the first samples were taken, as throughout a test, the taps were allowed to dribble so that average samples would be obtained. This complication involved the carriage of the standard solutions of ammonia and chlorine to the canal bank where the carts were dosed. After a few minutes' pause to ensure adequate contact, all concerned returned to the laboratories to prepare for the titrations and platings, while owing to the rough nature of the ground the carts were with difficulty brought to the laboratory within fifteen to twenty minutes, a frequent timing of first plating.

In all the experiments natural waters were used: (1) Bourley, an upland peaty water with a high iron content (0·02 to 1·4 parts per 100,000); (2) the Basingstoke Canal, a stagnant water full of weed, at which cows and sheep watered and used regularly by troops for bathing and boating. As the *coli* content of these waters was found to vary enormously, a condition which would materially affect results, it was deemed advisable to make further additions of *coli* cultures as indicators. The "indicator" organisms used were strains of *B. coli* recently isolated from water samples.

When comparing the relative values of the various combinations which were known to possess germicidal powers of a high order, 250 cubic centimetres of broth culture containing 1,000 million organisms per cubic centimetre were added to each water-cart of 110 gallons and in the later experiments each cubic centimetre contained twice this number of organisms. When the velocity of germicidal action was being investigated, agar cultures of the same organism suspended in water were employed as indicators. The water in the carts was clarified by filtration through clean filter cloths, with or without superimposed alumina films.

During the attempts at making concentrated solutions of these chlorine-ammonia bodies in a large funnel, it was observed that the use of small

ratios of NH_3 in extremely dilute solution, i.e., ratios of $Cl_2 : NH_3 : : 1 : \frac{1}{15}$ or $\frac{1}{10}$, had resulted in little loss of available chlorine, the production of compounds with a smell other than chlorine and the appearance of a combination which in parts per million gave the second titration fraction. It, therefore, appeared essential to determine the optimum combining ratios of chlorine and ammonia for the treatment of bulk samples.

To supplement the cart experiments which involved so much labour, eleven gallon glass accumulator tanks were used. The employment of five or six of these at a time under identical conditions of temperature, etc., offered distinct advantages. The results obtained in these were confirmed in the water-cart. As a matter of fact more accurate results were frequently obtained in the glass tanks than in water-carts containing baffles, and for experiments demanding finer readings these were always used. On trying out the various combinations it was found that when the ratio of ammonia to chlorine fell below 1 : 4, e.g., 1 : 15 or 1 : 10, the bulk of the solution was ordinary chlorine which was readily absorbed in certain waters, and only small amounts of chlorine-ammonia compounds appeared.

In the experiments employing the scheme of pouring as detailed above, it was only when the Cl_2 and NH_3 solutions contained ratios of 4 of Cl_2 to 1 of NH_3 that good results were obtained. As a matter of fact, $Cl_2 : NH_3 : : 4 : 1$ was found to be inferior to $Cl_2 : NH_3 : : 2 : 1$ on warm days when treating waters with a high iron content, e.g., the Bourley water often appeared almost red and frequently showed a content of 0·16 parts per 100,000.

Further examination of the relative ratios revealed that the best results were obtained by using concentrations of $Cl_2 : NH_3 : : 2 : 1$ and $1 : 0{\cdot}75$, and frequently it was quite safe to use ratios of 1 : 1. Increase of NH_3 above this ratio was not beneficial.

When employing the higher ratios of ammonia to chlorine it was found that the germicidal velocity maintained a high level and on certain occasions little or no second fraction appeared. Also the use of ratios of $Cl_2 : NH_3 : : 2 : 1$ frequently produced an equal first and second fraction. With ratios of $Cl_2 : NH_3 : : 4 : 1$, a larger amount of second titration fraction resulted and on certain occasions no first fraction appeared. It was then noticed that this ratio was not conducive to increased germicidal velocity. Up to this time the chief aim had been the production of this compound giving the second titration fraction.

Out of the tangle it appeared that a ratio of $Cl_2 : NH_3 : : 2 : 1$ and up to 1 : 1 was correlated with the appearance of the first fraction which gave the Wagner reaction (blue colour with starch and KI without acid) and that this body was produced by a combination of equivalents of Cl_2 and NH_3. Where ratios of $Cl_2 : NH_3 : : 4 : 1$ (2 equivalents of Cl_2 with 1 of NH_3) were utilized, a compound which gave a big second titration fraction resulted.

The germicidal powers of these compounds were investigated and the results fulfilled expectations. A few typical results are appended :—

(1) Cart experiment. Canal water pumped through filter cloths on reels without using alum, 500 million *B. coli* added as indicators:—

NH_3 0·75 p.p.m. + Cl_2 1·5 p.p.m.

Platings, half hour, all negative.

(2) Canal water with *B. coli* in $\frac{1}{10}$ cubic centimetre pumped through reels using alum; $\frac{1}{2}$ p.p.m. NH_3 + 1 p.p.m. Cl_2.

Platings 20 minutes, 1 colony.

40 minutes, negative.

(3) Crude canal water full of mud after heavy rain and boating.

Indicators: 500 million *B. coli;* 0·75 p.p.m. NH_3 + 1·5 p.p.m. Cl_2, after twenty minutes platings negative.

(4) Crude canal water—pea-soup colour—people bathing and boating. Crude water pumped direct from canal as in (3), and 500 million *B. coli* added.

NH_3 0·5 p.p.m. + Cl_2 1 p.p.m.

20 minutes, 27 colonies.

40 minutes, negative.

Attention was now directed to the production of these compounds in higher concentration with a view to their examination and identification. After numerous attempts the use of strong ammonia solution was abandoned and a steady reduction in strength was made until subsequent titration revealed no loss of available chlorine. This concentration was found to be the optimum when using a simple method of mixing prior to dosing.

Later by means of simple apparatus and the use of ammonium salts, solutions containing concentrations of 780 to 3,800 parts per million were made.

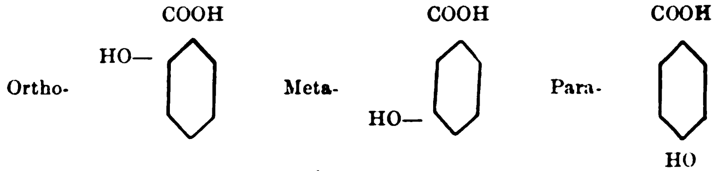
Stronger evidence was obtained that we were dealing with two bodies, and if to a combination of equivalents of Cl_2 and NH_3 a further addition of an equivalent of Cl^2 is made a change of one compound to the other can be demonstrated.

The Effect of Chemical Composition upon Germicidal Activity.

The aim of chlorination is the destruction of germs which is a biological action. Present-day teaching tends to focus the attention upon a purely chemical aspect, the amount of available chlorine is chiefly stressed, and the various chemical reactions of chlorine in water and in air are carefully expounded. Little importance is attached to the fact that the chlorine used may be free or combined with a particular base (Ca, Na, NH_3). Still it is well-known that what may appear to be an unimportant chemical variation may give rise to different biological results.

[6] If for instance the physiological actions of ortho-meta-, and para-oxybenzoic acids are compared although the only difference between these

compounds is a variation in the position of the hydroxyl group their actions will be found to be dissimilar.



If such a small variation in the intra-molecular arrangement produces such an effect, one naturally is not surprised that the attachment of various bases to chlorine modifies its germicidal action, and this was brought out in the previous communication. It is true that laboratory and practical results do not always correspond, but as a rule the laboratory usually gives a lead.

The amounts of chlorine and bleach employed in the Army which are inseparable from our urgent needs would frequently be regarded as superchlorination in water-works practice and therefore it is difficult to obtain comparative figures.

The relative efficiency of chlorine gas to bleach has been variously estimated in America as being from 3 : 1 to 10 : 1 [7]. The higher ratios being apparently dependent upon inadequate mixture and imperfect extraction of chlorine and hypochlorite from bleach powder.

Superchlorination promotes rapid germicidal action, irrespective of the varying chemical content of waters, but by mass action it also gives rise to greater absorption and the vexed question of taste is prone to arise [8].

Using bulk samples, the three main disturbing factors affecting germicidal action are: (1) Irregularity of dosage and contact; (2) variation in time of exposure; (3) differences in temperature. Nos. (1) and (2) have been eliminated by the efficient mixing of freshly prepared solutions and using fixed times approximating to conditions imposed by field service. No. (3) by using the same waters for each series of tests and only strictly comparing the results obtained on the same day. The last fallacy has entailed the performance of a very large number of experiments.

[9] Certain data regarding the action of chlorine and some of its compounds being available it was deemed advisable to extend this investigation to others. HClO is frequently stated to have a particularly toxic action on bacteria and is claimed to be a better oxidizing agent than Cl_2. This was prepared by my late colleague, Captain Ward, and titrated against standard alkali and thiosulphate. It was found to be inferior to chlorine against a suitable load of pollution, and also it was more readily absorbed by water.

Employing the pouring method, and using ammonia in conjunction with HClO in the same ratios as used with chlorine solution, the absorption of HClO was minimized and a compound of NH_3 and HClO was formed, endowed with a germicidal power superior to chlorine solution.

Ammonium hypochlorite prepared by double decomposition of bleach solution and ammonium oxalate was found to have a greater germicidal velocity than the above. Owing to the fact that bleach is not a pure hypochlorite, but contains lime, it is obvious that the excess NH_3 thrown out

of combination may exercise a disturbing influence, and at one point during the manufacture the smell of chloramine became noticeable.

An attempt was now made to make a pure ammonium hypochlorite by adding dilute ammonia to hypochlorous acid. Violent chemical action ensued, resulting in loss of available chlorine by the formation of ammonium chloride and the evolution of N_2; some chloramine also appeared. Later, by adding hypochlorous acid to weak ammonia in appropriate ratios and mixing the while, a solution having considerable bleaching powers and not having the noticeable smell of chloramine was made.

The germicidal activity of this compound appeared comparable to ammonium hypochlorite made by double decomposition, and again the possibility seemed to arise that this body might change over to chloramine as is suggested by Race [10]. The last compounds to come under review were the chloramines, and they were found to possess a germicidal power superior to all others against suitable loads of pollution.

When employing the pouring method in tanks and carts, if the chlorine solution is added first and the ammonia solution afterwards instead of the reverse, it is found that the whole of the chlorine is fixed, and that a first titration fraction is obtained.

Up to the present no means have been devised whereby this compound can be distinguished from chloramine formed by the interaction of equivalents of Cl_2 and NH_3 except by its inferior germicidal power.

For the successful formation of chloramines it appears essential that Cl_2 solution must be brought into contact with a very much weaker ammonia solution, when possibly a somewhat different intramolecular arrangement results.

It therefore transpires that chlorine possesses innate germicidal and oxidative powers. Improvement in oxidative power by the formation of HClO does not enhance the germicidal action. That oxidation implies absorption of chlorine and consequent loss of germicidal activity. If oxidation is restrained and absorption impeded, greater germicidal power can be anticipated. The attachment of a NH radicle exercises a marked effect which is not further enhanced if the compound possesses additional oxidative powers as in the case of ammonium hypochlorite above. Lastly, the action of chlorine being a biological one, the stock chemical equations representing its action in air and water offer no elucidation of this its essential function beyond indicating its presence and the means of its ultimate disposal.

The above results confirm Race's deductions and work [11], *vide* his table comparing the oxygen equivalents and germicidal power of bleach and pot. permanganate, etc.

Regarding the superior germicidal powers of the chloramines.

Examination of the albuminoid ammonia figures, given in the section on colloids, indicates that the waters used for these experiments (Basingstoke canal) contained large amounts of colloid, even after clarification, and are comparable with ones which normally would be met on service.

(1) Rideal showed, in the presence of glue (colloid), ammonia and chlorine solutions interact and chloramine is formed [12]. Here the colloid may be described as exercising a damping effect upon the energy of chemical action, favouring the production of chloramine, and permitting of the interaction of stronger concentrations. In addition the impression has been gained that colloid may adsorb chloramine, and that a colloid solution under some conditions is more retentive of chloramine than relatively pure water.

(2) Seeing that colloid invests organisms and from it they extract nourishment, the assistance of colloid in bringing about their destruction is obvious.

(3) As indicated by Rideal [13], the NH group being reactive with cellulose and chitin should possess superior germicidal powers.

Race's experimental results lead him to favour the view that in the presence of extremely small amounts of organic matter chlorine, hypochlorites, and chloramine are all equally effective because there is the same amount of available chlorine in each case. When the organic matter is increased, a portion of the chlorine or hypochlorite is used up in the oxidation process, and less is available as a germicide. Chloramine under these conditions has no oxidizing power, and the whole of the chlorine is available.

For our own part we have noted when using agar cultures in pure waters (no colloid present) that chlorine is practically instantaneous in its action. Chloramine is slower, but tends to work at the same velocity both in pure water and in the presence of moderate colloid pollution.

Comparative tests with waters containing colloid using equal quantities of chlorine and chloramine, indicate that under these conditions chloramine is superior, and with our normal contact periods colloid is not readily amenable to oxidation by chlorine, although disintegrative products exercise a marked effect. On occasions small concentrations of chlorine, as low as 0·1 p.p.m. in excess of immediate absorption, given indefinite contact, may possess marked germicidal powers even in the presence of considerable colloid pollution.

These results are capable of simple interpretation. The chlorine in chloramine is stabilized by its NH group and cannot react with colloid. Whereas chlorine being extremely active probably does enter into some form of loose combination which hampers its germicidal action. It cannot therefore readily attach itself to the organism—the combination is probably only slowly absorbed by it, and may be less lethal in action. It certainly does not possess the penetrative quality induced by the NH_2 group.

Experiments carried out with chloramine against heavy bacillary anthrax emulsions indicated that it was equally effective both in the presence and absence of colloid. Against spores it was slower in action in the presence of colloid.

Supporters of the parasitotrophic theory of colloid might point out that a spore does not absorb nourishment from a fluid medium. The true

explanation of this appears to be that in these experiments the colloid used was a thirty-per-cent. gelatine solution which is fluid at laboratory temperatures after subjection to repeated autoclaving. The addition of such solutions to strong aqueous chloramine gives rise to an increased evolution of chloramine during diffusion and accounts for this discrepancy.

Having regard to the above, and, in view of the opinions expressed in the section on taste it is suggested that in this connexion possible linkages of chlorine with colloid groupings claim consideration even if absorption of chlorine does not render these apparent.

Lastly, sterilants which are effective in the presence of colloid are eminently suited to Army practice.

STABILITY.

Effects of heat and light:—

Chloramines can be distilled under reduced pressure, and so withstand reasonable temperatures [14]. When dosed into water their absorption is hastened by both heat and light, but, at the same time their germicidal velocity is enhanced.

In one experiment solutions containing a concentration of 25 p.p.m. made by the interaction of equivalents of Cl_2 and NH_3 and two equivalents of Cl_2 and one of NH_3 at 21° C., giving typical titration figures, were slowly raised to boiling point and titrated at each ten degrees rise of temperature. The character of the titrations was unaltered and the chlorine content remained constant until a temperature of 80° C. was reached, after which a gradual fall occurred.

Cart Experiment.—Two water-carts filled from the Basingstoke canal on April 22; previous day Bank Holiday, and canal had been used for boating, etc. Water clarified by use of clarifying powder in box-heads of cylinders. Indicators, 25 c.c. of a water suspension of agar culture, containing 1,000 million organisms per c.c. per water-cart.

A = 1 part per million of Cl_2 + ½ p.p.m. NH_3 by two-way tube.

B = 1 part per million of chlorine.

Titration and plating after twenty minutes:—

$$A = \frac{0{\cdot}20 \quad 0{\cdot}45}{0{\cdot}65} \qquad B = 0{\cdot}1$$

Plates:—

Negative. Plate 100 colonies.

After four hours, plates from B showed 50 colonies per plate.

(A) Recontamination with 25,000 mil. organisms after four hours.

$$\text{Titration} = \frac{0{\cdot}25 \quad 0{\cdot}25}{0{\cdot}5}$$

One hour after contact platings were negative.

$$\text{After 7 hours, titrations} = \frac{0{\cdot}2 \quad 0{\cdot}2}{0{\cdot}4}$$

$$\text{,, 24 ,, ,,} = \frac{0{\cdot}15 \quad 0{\cdot}1}{0{\cdot}25}$$

Tank Experiment.—Three 11-gallon tanks in dark room. The equivalent dose of 1 p.p.m. of Cl_2 and $\frac{1}{2}$ p.p.m. of NH_3 were allowed contact under varying conditions and added to each tank.

Titration		(A) Contact in a flask with 5-minute interval	(B) Mix at once in a flask and pour	(C) As in cart
After 1 hour	..	0·25 0·4 / 0·65	0·6 0·25 / 0·85	0·35 0·45 / 0·80
,, 24 hours	..	0·15 0·2 / 0·35	0·5 0·0 / 0·5	0·25 0·25 / 0·5
,, 96 ,,	..	0·1 0·0 / 0·1	0·3 0·0 / 0·3	0·5 0·05 / 0·25
,, 168 ,,	..	—	0·15 0·0 / 0·15	0·05 0·0 / 0·05
,, 192 ,,	..	—	0·05 0·0 / 0·05	—

A very striking demonstration.

Attractive characteristics, from the point of view of general utility, are the stability and reliability of these compounds enabling them to be added to crude water, in which they resist absorption and work effectually in the presence of colloid. Also, when using sand filtration the restraint of growth should entail a considerable saving, and in addition as they remain in useful quantities in water for days the possibility of after-growth is reduced.

Significance of Foregoing Remarks.

It is with diffidence that the writing up of this section has been undertaken. The main object of this work has been the production of germicides from simple gases suitable for use in Army practice, e.g. :—

(1) Endowed with high germicidal powers and capable of employment in smaller dosage, thereby obviating taste ;

(2) Not readily absorbed by natural waters, even when heavily charged with organic matter ;

(3) Dissipated by heat, leaving no residue, non-reactive with tannin or tea extractives—an important point when tea is the normal Service beverage.

It can be claimed that in pursuit of this our main objective success has attended these efforts. Of secondary importance is the identification of the compounds, which has been a matter of considerable difficulty. The assertion that these are simple chloramines or bodies of a closely allied nature has only been arrived at after careful consideration and experiment, and for their successful preparation rigid attention to certain detail of procedure and concentration appears essential.

[15] These chloramines may be defined as compounds of chlorine with N, NH and NH_2 groups possessing superior germicidal powers, not readily absorbed by organic matter, and having little bleaching effect on dye. [16] They are said by some to give a more pronounced Wagner reaction than equal amounts of chlorine and hypochlorite. It is also noted that

with our usual indicator starch and KI the blue colour develops rather more slowly than with Cl_2. These compounds have been made by the interaction of hypochlorite and ammonia and subjected to careful examination and experiment by Raschig, Rideal, Race and others. The effect of the attached base in hypochlorite would appear to modify the energy of reaction, and so permit of the use of stronger solutions of chlorine and ammonia.

The same results have been obtained in Aldershot by employing porous diaphragms, whereby the energy of chemical action is restrained.

[17] Race has come to the conclusion that the addition of ammonia to chlorine solutions diminishes the property of liberating iodine from potassium iodide, the bleaching effect on dye-stuffs and the germicidal activity. This is also our experience. Successful results can only be obtained if firstly the ammonia is initially added to water, and secondly, the concentration of ammonia is extremely low.

The usual causes of failure appear to be the use of too strong ammonia solution and the dosing of the ammonia into the chlorine instead of the reverse. The ideal being, that, at the point of contact, the concentration of the Cl_2 should be greatly in excess.

After writing up this paper, Race kindly forwarded for perusal a paper by F. W. Tilley [18]. This worker carried out a very complete examination of the germicidal value of some of the chlorine disinfectants, and demonstrated the influence of ammonia upon the germicidal efficiency of these—particularly the good effect upon Dakin's solution and the excellence of this mixture in the presence of blood-serum (colloid).

In the light of our present knowledge the experiments indicating the value of chlorine in association with ammonia are not convincing, e.g., Experiment 29 shows that, compared with the original chlorine solution, the addition of an equivalent of ammonia to chlorine solution results in an inferior germicidal action against a watery suspension of organisms, although the mixture is much more effective in the presence of blood-serum (chloramine produced).

In these experiments it appears that ammonia equivalents were added to chlorine solutions of considerable strength; but, as titration tables are not appended, the final chlorine content of these mixtures cannot be gauged. In our experience considerable loss of available chlorine is inevitable under these conditions and would explain the results. The improved action of this mixture in the presence of colloid (blood-serum) is undoubtedly due to the formation of some chloramine.

Experiment 31 demonstrates that the ideal mixture is a molecular chlorine equivalent with half a molecular equivalent of ammonia, but if these records are compared with those of Experiment 29, this mixture in water does not appear to be superior to a chlorine solution of similar strength.

Experiment has convinced us that with relatively strong solutions of Cl_2 and NH_3, reduction in the amount of NH_3 used frequently leads to an

increased chloramine production, a smaller loss of available Cl_2 by the formation of NH_4Cl, HCl, and the evolution of N_2, and, under these conditions, mixtures containing one-half and one-quarter equivalents would give better results.

[19] It is here considered opportune to reply to Race's criticism appearing in the *Lancet*, September 13, 1924. Superchlorination is still the standard Army practice with the Regulation Water Sterilizing Lorry. Prior to the publication of our first paper, successful laboratory results with natural waters had been obtained, and in addition a new technique applicable to natural waters in the regimental water-cart had been in use for several months and was giving excellent results.

In regard to the partial failure of our original flask technique when applied to bulk natural samples, the unfailing success attending our original laboratory experiments was largely contributed to by the use of autoclaved water, in which an increase in the pH value had taken place. Still parallel results had been obtained with natural waters, and the present work is the direct outcome of these experiments.

The second point. The natural waters taken into use afterwards were often acid in type and tended to interfere with the initially dosed ammonia.

Thirdly, during the diffusion of chlorine through ammonized water prior to its combination with ammonia, nitrites, iron and easily oxidizable matter were occasionally encountered leading to considerable losses of available chlorine.

Fourthly, it has been observed that if ammonia and chlorine in ideal concentrations are permitted initial contact prior to dosage, the compounds produced are more stable, and have a higher germicidal velocity than those obtained by adding the chlorine in correct proportion to a water containing, say, a half part per million of ammonia, e.g., the action of chloramine in a water containing one to four parts per million of ammonia is far more effective than the same amount of chlorine in a water with a similar content.

The next problem to be considered is the second titration fraction which, in association with an improved germicidal action, initially attracted attention. If Cl_2 solution, calculated to give one part per million, is added to water samples containing from a half to ten parts per million of ammonia, the following titrations may be expected :—

Amount of NH_3 present in parts per million	½	1	2	4	6	10
Titration of 355 c.c. against N/100 thiosulphate solution	$\frac{0{\cdot}8 + 0{\cdot}1}{0{\cdot}9}$	$\frac{0{\cdot}7 + 0{\cdot}2}{0{\cdot}9}$	$\frac{0{\cdot}5 + 0{\cdot}3}{0{\cdot}9}$	$\frac{0{\cdot}4 + 0{\cdot}5}{0{\cdot}9}$	$\frac{0{\cdot}2 + 0{\cdot}7}{0{\cdot}9}$	$\frac{0{\cdot}025 + 0{\cdot}875}{0{\cdot}9}$

It will be seen that even with this large excess of ammonia, ammonium

chloride is not formed, but a second titration fraction increases with the amount of ammonia present. Chloramine formed by the interaction of equivalents of chlorine and ammonia and dosed into water containing ten parts per million of ammonia is affected in the same way.

E.g., immediate titration $= \frac{0{\cdot}35 + 0{\cdot}35}{0{\cdot}7}$; after twenty-four hours $\frac{0 + 0{\cdot}7}{0{\cdot}7}$

Remarks.—Hydrazine not detected.

Under these conditions, with an increasing second titration fraction, germicidal velocity is impaired. This interference with the usual titration is possibly due to the presence of excess base as in the case of hypochlorites.

It had been observed that when a strong chlorine solution had been pipetted to the bottom of a flask or funnel containing dilute ammonia and left for some time as a concentrated stratum of solution, a combination giving a different second titration fraction resulted. This also appeared with great regularity when using ratios of chlorine to ammonia of 4 to 1, or an equivalent of chlorine with half an equivalent of NH_3. At times the whole of the available chlorine appeared in this form; on titration no first or free chlorine fraction resulted, the compound requiring acid for its immediate titration.[1] On these occasions no material improvement in the germicidal velocity was noted. When chlorine is added to extremely dilute ammonia solution in the ratios of 2 to 1 (equivalents) and rapidly mixed, two types of titration are prone to arise. First, a titration showing the whole of the chlorine as free, and no second fraction, or an equal production of a first and second fraction, associated with these titration results in a germicidal velocity of an extremely high order, and for military use this combination has been preferred to the compound obtained by the mixture of 4 to 1 ratios.

If to a solution giving the above titration (produced by the interaction of equivalents of NH_3 and Cl_2) a further addition of an equivalent of Cl_2 is made, so that the ratio of $Cl_2 : NH_3$ becomes 4 : 1 instead of 2 1; it is possible to change over this compound to the former, and a very definite alteration takes place in the titration results, smell, taste, and as is demonstrated later, solubility in CCl_4.

The following experiment, carried out at Aldershot in the presence of Mr. Race, exemplifies this.

To a series of flasks containing varying amounts of ammonia by weight, one part of Cl_2 was added and rapidly mixed. They then contained the following ratios of Cl_2 to NH_3 by weight:—

A	B	C	D	E
Cl_2 only	$1Cl_2 + \frac{1}{8} NH_3$	$1Cl_2 + \frac{1}{4} NH_3$	$1Cl_2 + \frac{1}{2} NH_3$	$1Cl_2 + \frac{1}{2} NH_3$

These were left under covers on the bench for two and a half hours.

Twenty cubic centimetres of solution diluted to 300 c.c. with tap water gave the following titrations against N/100 thiosulphite solution:—

[1] Compared with a combination of equivalents.

A	B	C	D	E
1·5	1·0	1·5	1·3	1·2

These solutions were poured into eleven gallon glass tanks and allowed half an hour's contact. The amount of Cl_2 added to the flasks had been calculated to give 1 p.p.m. in each tank.

	A	B	C	D
Titration of 355 c.c. against N/100 thiosulphate	$\frac{0{\cdot}4 + 0}{0{\cdot}4}$	$\frac{0{\cdot}1 + 0{\cdot}4}{0{\cdot}5}$	$\frac{0{\cdot}2 + 0{\cdot}7}{0{\cdot}9}$	$\frac{0{\cdot}1 + 0{\cdot}7}{0{\cdot}8}$

Remarks.—(A) Note absorption of Cl_2. (B) Note large second fraction and also loss by absorption of free Cl_2. (C) Note large second fraction and little absorption. Note all first fraction.

20 c.c. of solution from flask E, which is similar to D, had been allowed half-an-hour contact with 300 c.c. water. The titration obtained $\frac{1 + 0{\cdot}2}{1{\cdot}2}$ is very similar to D above. To this flask another volume of Cl_2 was added, well mixed and allowed a short contact. 20 c.c. of the resulting solution was titrated after contact with 300 c.c. water, and instead of a larger first free fraction appearing the 1 + 0·2 titration was converted to a titration = 0 + 2·5 giving a second fraction only.

The indications are that we are dealing with two chloramines. Occasionally, with ratios of 2 of Cl_2 to 1 of NH_3 the whole of the available Cl_2 gives the Wagner reaction (first fraction titration) and also with ratios of 4 of Cl_2 to 1 of NH_3 the whole of the available Cl_2 may be titratable as second fraction, and no first fraction appears. As a general rule both compounds appear in unequal quantities, depending upon the relative proportions of NH_3 used. With regard to smell and taste these solutions placed side by side are distinguishable from each other—the 4 : 1 ratio having a more acrid smell and pronounced taste, the 2 : 1 ratio having a dry taste and a less distinctive smell. At Mr. Race's suggestion solutions of these compounds were extracted with CCl_4 and CS_2.

Initially it was found that hypochlorous acid, bleach solution and ammonium hypochlorite were not extracted from aqueous solution. It was next observed that although chlorine was readily extracted from a strong solution, in a concentration of 25 p.p.m. it behaved like HClO and remained in the aqueous residue. In a concentration of 250 p.p.m. it was present in the solvents and in the aqueous residue in almost equal amounts.

A series of flasks were examined containing chlorine and combinations of $Cl_2 + NH_3$ in a concentration of 25 p.p.m.

A = Cl_2 only. B = 1 Cl_2 + $\frac{1}{4}$ NH_3 C = 1 Cl_2 + $\frac{1}{2}$ NH_3

Immediate titration of these in 500 c.c. of water gave the following :—

$$\frac{1{\cdot}1 + 0}{1{\cdot}1} \qquad \frac{0 + 1{\cdot}4}{1{\cdot}4} \qquad \frac{0{\cdot}9 + 0{\cdot}3}{1{\cdot}3}$$

Extraction of 20 c.c. of A with CCl_4 which was then titrated in 500 c.c. of water revealed no free chlorine in the solvent, and the water residue made up to 500 c.c. with tap water gave a titration of $\frac{0{\cdot}7 + 0}{0{\cdot}7}$ showing considerable loss of available Cl_2. With CS_2 the same result was obtained.

(B) Twenty cubic centimetres extracted with CCl_4 and CS_2.

$$CCl_4 \quad \underbrace{\frac{0 + 0{\cdot}7}{0{\cdot}7} \quad \text{in } CCl_4 \quad \frac{0 + 0{\cdot}6}{0{\cdot}6}}_{1{\cdot}3} \quad \text{in water residue}$$

$$CS_2 \quad \underbrace{\frac{0 + 0{\cdot}9}{0{\cdot}9} \quad \text{in } CS_2 \quad \frac{0 + 0{\cdot}6}{0{\cdot}6}}_{1{\cdot}5} \quad \text{in water residue}$$

(C) Twenty cubic centimetres extracted with CCl_4 and CS_2.

$$CCl_4 \quad \underbrace{\frac{0{\cdot}1 + 0{\cdot}2}{0{\cdot}3} \quad \text{in } CCl_4 \quad \frac{0{\cdot}9 + 0{\cdot}2}{1{\cdot}1}}_{1{\cdot}4} \quad \text{in water residue}$$

$$CS_2 \quad \underbrace{\frac{0{\cdot}1 + 0{\cdot}2}{0{\cdot}3} \quad \quad \frac{1 + 0{\cdot}1}{1{\cdot}1}}_{1{\cdot}4} \quad \text{in water residue}$$

The above demonstrates that in this concentration the compound chiefly present when the ratio of Cl_2 to NH_3 is as 2 : 1 is not extracted by these solvents, and the combination formed by ratios of $Cl_2 : NH_3 :: 4 : 1$ is soluble equally in water and CCl_4 and CS_2. On occasions the whole of this fraction is extracted by these solvents leaving only a trace in the watery residue. At a later date, when a compound of a similar nature was made by the interaction of Cl_2 with NH_4Cl, it was again observed that this, on occasions, was also more soluble in the above solvents than in water.

[20] Examination of the chloramines made by Race's method, from bleach and ammonia, revealed that when ratios of $Cl_2 : NH_3 :: 2 : 1$ were allowed contact and dosed into water in parts per million, the typical titrations given by compounds formed by the interaction of equivalents of NH_3 and Cl_2 resulted.

E.g., titration of 355 c.c. of water containing 1 p.p.m. = $\frac{0{\cdot}7 \quad 0{\cdot}2.}{0{\cdot}9}$

Treatment of a solution containing 25 p.p.m. with the above solvents extracted a trace of chloramine only.

Chlorine as hypochlorite and NH_3 in ratios of $Cl_2 : NH_3 :: 4 : 1$ gave a titration in water of $\frac{0{\cdot}3 \quad 0{\cdot}5,}{0{\cdot}8}$ which shows a tendency to an increased second fraction formation, but again only a small proportion of this was extracted by CCl_4. These results indicate that mixtures of bleach and NH_3 tend to give the same results as solutions of NH_3 and Cl_2 but with the ratios of $Cl_2 : NH_3 :: 4 : 1$; although there is an increase in the second titration fraction, the combination produced is not so well defined as the one made from Cl_2 and NH_3 solution, and little solubility in CCl_4 results. This is probably due to interference by Ca.

[21] Hale, who tried this ratio of hypochlorite and ammonia for the treatment of water in New York, came to the conclusion that it consisted of a mixture of hypochlorite and chloramine. Possibly under different conditions of temperature and contact, better results would be obtained.

Reviewing the relationship of ratios of ammonia and chlorine to the titration results, it is seen that if chlorine is allowed contact with NH_3 in the manner detailed in the experiments, a compound due to the interaction of an equivalent of NH_3 and 2 of Cl_2 results, which in selected concentrations is soluble to a considerable extent, and on occasions entirely extracted by CCl_4 from aqueous solution. It also tends to give a larger or complete second fraction titration figure when dosed into water, and requires acid for its immediate titration.

With contact of equivalents of Cl_2 and NH_3 a combination giving a first fraction titration like chlorine or an equal proportion of first and second fractions is formed. Little, if any, of this combination is extracted by CCl_4, and the above compounds possess germicidal powers of a high order. If the ratio of NH_3 is further increased and becomes $Cl_2 : NH_3 :: 1 : 1$ to 1·25, the titration is as a rule entirely a first fraction titration. This combination is also not extracted by CCl_4 and the increasing ratio of NH_3 is accompanied by a rapidly decreasing germicidal velocity corresponding to the effect produced by dosing a tank or cart with NH_3 first and Cl_2 afterwards.

It is also possible to produce a second titration fraction in another way, viz., by dosing Cl_2 or the above compounds into water containing, say, 5 to 10 p.p.m. of NH_3. Here the germicidal velocity is very much retarded and after prolonged contact a total second fraction titration is observed. This combination is not extracted by CCl_4 and the effect is most probably due to excess base. Examination of these waters for hydrazine gave negative results.

The above points confirm the opinion formed regarding the dissimilarity of these compounds giving a second titration fraction.

After scrutinizing these problems from many angles and carrying out a large number of experiments, the general impression gained is that this ammonia chlorine group is a chemical complex. When ammonia in half part per million is added to water and is not affected by a low pH value, and if the chlorine prior to contact with it is not adversely affected by nitrites, etc., the chlorine is fixed by the ammonia, absorption is blocked, and a compound *en route* to chloramine is formed. The germicidal power of this compound is not as effective as chloramine under all conditions.

There is in addition a compound of HClO with NH_3 which has certain bleaching properties and is also an effective germicide ; it apparently may also change over to chloramine.

If chlorine solution is placed in contact with dilute ammonia in ideal concentrations chloramine is produced.

Chloramine may apparently be regarded as consisting of two compounds, one produced by the interaction of an equivalent of Cl_2 with an equivalent of NH_3, the second by the interaction of two equivalents of Cl_2 with one equivalent of NH_3 ; consequently these compounds may be named monochloramine and dichloramine.

Later it was discovered that a compound possessing the same characters and powers as the combination formed by the interaction of two equivalents of Cl_2 and one of NH_3 could be made in high concentration by the action of Cl_2 solution on NH_3 salts.

These compounds appear to correspond to the combination described as chloramine made by the interaction of bleach and ammonia and used with such success by Race in the treatment of water. To follow a line of thought as to the reason why ammonium chloride is not formed by the interaction of NH_3 and Cl under these conditions. Ammonia is a half-electrolyte and Cl_2 in solution is poorly ionized. These are in contact in parts per million, and in this concentration Cl_2 behaves in regard to CCl_4 and CS_2 in a similar manner to HClO. The possibility arises that these compounds may result from attachments of Cl_2 to NH_3 very near to hypochlorite and a subsequent change over to chloramine follows. The same may also apply to compounds made by the interaction of hypochlorite and NH_3 in dilute solution where a gradual displacement of Ca by NH_3 may take place, and, as Hale [22] has pointed out, when the bleach and ammonia mixture is ideal the available chlorine content resulting is identical with the amount of Cl_2 added as bleach.

As far as the chemical composition of these compounds is concerned it is at present advisable to keep an open mind. After considering the results obtained with ammonia and chlorine solutions the designations monochloramine and dichloramine seem appropriate, but in view of the fact that nitrogen trichloride is formed by the interaction of chlorine with ammonia and ammonium chloride, the possibility arises that the second titration fraction compound may prove to be an aqueous solution of nitrogen trichloride.

However in this case the chemical reactions proceed in several stages and with the employment of fixed ratios of reagents, it appears to be a matter of some difficulty to preclude the possible formation of a compound with the chemical composition of dichloramine.

From the practical point of view these compounds give the general reactions of chloramine, possess similar germicidal powers, and this as far as the sterilization of water is concerned is the all important matter, although academically an interesting field of chemical inquiry is disclosed.

A suggestion regarding the reactions involved in the change over to chloramine is appended:—

$$NH_4OH + HClO = NH_2Cl + 2H_2O$$
$$NH_4OH + 2HClO = NHCl_2 + 3H_2O$$

(*To be continued.*)

A CORRESPONDENCE CIRCLE.

VIII.

Research on the Commoner Tropical Diseases.

By PHILIP MANSON-BAHR, M.D., F.R.C.P.
Physician to the Hospital for Tropical Diseases.

There is hardly one aspect of clinical importance even in the commoner diseases of the tropics, which does not require reinvestigation. It is too commonly assumed that research work in tropical disease is necessarily confined to the laboratory investigator, but this is by no means so, and in these notes I shall attempt to suggest the lines on which such investigations should proceed. I need hardly point out that officers in the Royal Army Medical Corps, especially those serving in India, are favourably placed for making observations of great importance on the treatment of disease, and that in the Journal of the Royal Army Medical Corps they will always find a ready means of publication of their results.

Malaria.

I.

Observations are required upon the exact mode of action of quinine upon the malaria parasites, especially as to the reason why this drug should act more efficaciously upon the subtertian parasite than on the benign. My own observations go to show that the more acute the onset of a subtertian infection and the more numerous the parasites, the more readily does the infection yield to quinine in the accepted therapeutic doses and the less liable it is to relapse. In fact I am of the opinion that genuine relapses of subtertian malaria after efficient quininization are extremely rare.

II.

The absorption rate of quinine does not appear to be proportional to the action of this drug upon the malaria parasites. More observations are necessary to ascertain whether intravenous injections of quinine can completely eradicate a benign tertian infection during a primary attack of this fever. It is quite possible that this is so.

III.

Certain French authorities have recently claimed that stovarsol (acetyl-oxy-aminophenyl-arsinic acid) has a specific action on the malaria parasite. This drug which contains twenty-seven per cent of arsenic must be given with caution and in moderate doses, or else signs of arsenical poisoning are apt to occur. So far stovarsol has been given in tablet form of four grains each day by the mouth for ten to fourteen days on end. One would

suggest that the intravenous injection of stovarsol in the same dosage should be given a trial in benign tertian malaria, and the effect controlled by systematic daily blood examinations. Possibly, however, the effect of stovarsol upon the malaria parasite may be comparable with that of salvarsan and it may act most efficaciously when combined with moderate quininization.

IV.—*Diagnosis.*

More exact methods than those at present in use are required to diagnose latent malaria, when neither the parasites nor the characteristic pigment can be found in the blood on microscopic examination. The proportional count of large mononuclear cells is too uncertain a factor and too dependent upon the "personal equation" of the observer to be of much permanent value. The discovery of a specific complement deviation reaction would be of inestimable value. The difficulty mainly rests in the preparation of a satisfactory antigen. Attempts in this direction which have been made with extracts from spleen pulp infected with malaria parasites in fatal cases have not been successful; nor is this surprising considering the amount of non-specific proteins such an alcohol extract must contain. Some years ago I attempted to obtain a specific antigen from an alcoholic extract of the stomach of anopheles infected with oöcysts of the malaria parasite; a considerable, but not insurmountable, difficulty may be experienced in obtaining a sufficient number of infected insects. This piece of research should be much more easily carried out in countries such as India, where suitable anopheles and malaria-infected patients are easily obtained and the conditions are favourable for the development of the malaria parasite within the mosquitoes. Possibly a watery or saline extract of the oöcysts may be more active than an alcoholic one. At any rate, it is extremely probable that some specific complement-deviation reaction occurs in chronic malaria as in other chronic protozoal blood infections.

Dysentery.

I.—(*a*) *Bacillary Dysentery.*

No recent and reliable statistics are forthcoming upon the actual therapeutic results of treatment with antidysenteric serum. In order to be of any permanent value a series of cases treated with antidysenteric serum should be compared with a similar series of cases of approximately the same severity, treated on other lines.

The type of the disease caused by Shiga's bacillus is usually the most severe and dangerous to life itself. The results would be more reliable were all serum-treated cases in such a series primarily proved to be due to the organism. Researches have been recently undertaken, especially in the Wellcome laboratories, to strengthen the serum in Shiga antitoxins. It is, therefore, advisable that the brand of serum to be used should be carefully selected and its antitoxic value ascertained.

II.—*Diagnosis* (*Clinical*).

Little work has been done upon the sigmoidoscopic appearances of the rectum and sigmoid during the more acute stages of the disease. Much information can be obtained upon the nature of the damage which has taken place and especially of the process by which repair of the mucous membrane is effected. An atlas of sigmoidoscopic paintings of the bowel in various stages of the disease would be most instructive. The mucous membrane of the rectum is almost invariably affected in bacillary dysentery; this inspection can readily be made without an anæsthetic and without seriously inconveniencing the patient.

III.—*Bacteriological.*

More observations are required upon the persistence of the dysentery bacilli in the fæces during the convalescent stages of the disease and more especially upon what is known as the "carrier state." It is a general impression that the normal symptomless "carrier" of dysentery bacilli does not exist.

IV.

The value of the serum reactions in diagnosis of bacillary dysentery has been seriously questioned. The whole subject requires reinvestigation by the *macroscopic* method of agglutination and the employment, in case of Flexner dysentery, of the five serological races of the dysentery bacillus. The chronic stage of bacillary dysentery is especially difficult to diagnose by bacteriological methods and it is important to ascertain whether serological methods are of distinct diagnostic value at this stage of the disease.

I.—(*b*) *Amœbiasis:*

The metastatic lesions of intestinal amœbiasis require further investigation. Do the amœbæ commonly invade the pulmonary tissues and, if so, by which route do they reach the pulmonary capillaries? Do amœbæ occur in any other organs such as the spleen and the pancreas? Is there such a condition as amœbic cystitis which has frequently been described?

II.—*Treatment.*

The ease with which the extra-intestinal lesions of amœbiasis may be cured by antiamœbic drugs, such as emetine, requires further elucidation. Does the explanation lie in the fact that the amœbæ are incapable of becoming encysted in these situations? Improvement in our methods of treating the chronic or "cyst passer" stage of the disease is urgently required. The introduction of a drug which possesses none of the disagreeable attributes or sequelæ of emetin and its compounds is a desideratum.

Two new drugs have recently come into use which promise well and if given in therapeutic doses are not attended by any disagreeable sequelæ.

III.

Stovarsol (already mentioned under the heading of malaria) is an organic arsenical compound. More exact and carefully controlled observations are necessary to ascertain the effect of the drug upon the cysts of ***Entamœba histolytica*** and its power of preventing clinical relapses of the disease. This control work, where a man may be kept under observation for weeks and months on end and frequent fæces examinations performed, can be better carried out in the Army than elsewhere.

IV.

Yatren ($C_9H_6O_4.SNI$) is a combination of iodine with oxyquinoline sulphonic acid and is primarily an intestinal antiseptic. It appears to be remarkably efficacious if injected in the acute stage of the disease as an enema composed of 200 cubic centimetres of water containing 3-5 grammes of the drug. The enema is retained and absorbed. Apparently a fourteen days' continuous treatment by this method suffices to eradicate an amœbic infection from the bowel. There are, apparently, no disagreeable sequelæ.

The confirmation of this discovery is urgently required, together with systematic sigmoidoscopic and stool examinations. The value of this work need hardly be emphasized.

Yatren is a yellow powder made by the Behringwerke, Marburg a/L, Germany, and can now be procured through the ordinary trade channels.

Hints to Majors R.A.M.C. for the Field Work of Part II. "Promotion to the Rank of Lieutenant-Colonel." K.R. Appendix X.

By Major P. S. TOMLINSON, D.S.O.
Royal Army Medical Corps.

THE following are a few of the hints which suggest themselves after sitting for this examination :—

(1) Read through Army Order 225 of 1924, which alters K.R. Appendix X, and realize the scope of the examination in Part II.

(2) Read carefully Field Service Regulations, Vol. I, Chapter XXII, and War Establishments 1923. (All Medical Units.)

(3) The following are suggested as necessary to take into the examination, and therefore to all practices prior to it :—

(*a*) Black and coloured pencils (e.g., red, blue, brown and green).

(*b*) Ruler, protractor, dividers and india-rubber.

N.B.—These are in addition to the usual series ordered (i.e., field-glasses, note-book, compasses, etc.).

(4) Learn *Grid Map Readings*, as grid maps are given out, and all references to positions are required in *grid* form.

N.B.—Remember the *S.W. Corner Square* of a large lettered square is always *OO*.

(5) Read "*Required Tasks*" carefully, underlining in colour the salient points, then special bits are not missed.

Mark the positions in the maps provided.

(6) When asked about *Medical Arrangements*, as A.D.M.S. or O.C. Field Ambulance, take a rough piece of foolscap and write down the following :—

(1) Your *Divisional R.A.M.C.* in order :—

A.D.M.S., D.A.D.M.S.

Sanitary Section.

Nos. 1, 2, 3, Field Ambulances (H.Q. Nos. 1 and 2 Coys.).

N.B.—*Do not* forget your D.A.D.M.S. ; he is most useful in many ways, but he is *not* with you at the examination.

(2) *All Posts* likely to be required :—

Relay Posts, Bearer Collecting Posts, Car Posts, Advance Dressing Stations, Walking Wounded Collecting Station, Car Rank, Main Dressing Station, also position of the A.D.M.S.

(3) *Dumps* of Stretchers, Blankets and Rations.

You can tabulate these in three columns, so that everyone is assigned a task.

N.B.—Unless the above are put down in front of you, one or more are likely to be forgotten.

(7) When *changing the positions* of Field Ambulances, either forward or backward (especially the latter), put down on paper each Field Ambulance (H.Q., No. 1 Coy., No. 2 Coy.), and underline each with different coloured chalk, e.g., red, blue, green, then you do not miss out one Company, which can easily be done.

N.B.—Remember to *leapfrog* your Field Ambulance.

(8) In *writing Orders* :—

See Field Service Regulations, Vol. II, Chapter VI (1920), Chapter XIV (1924).

Do not forget the following :—

(*a*) Right hand corner .... SECRET, and Date, and Copy No.

(*b*) Under the title .... Reference Maps (with Scale).

(*c*) Number the paragraphs as suggested in F.S. Regs.

(*d*) Do not forget "Acknowledge."

(*e*) Underneath write the following :—

On right .... signature.

On left .... time, place, and method of issue (e.g., issued at 18.00 hours from D.H.Q. by S.D.R.).

Also distribution and Copy Nos.

N.B.—Do not forget copies to Sanitary Section, War Diary and File, also to A.D.M.S.s on each flank.

You are allowed to have with you the *Field Service Pocket Book*, and

even the 1917 reprint gives orders and messages in Chapter III which can be looked up.

(*f*) Send a draft of your orders for insertion in Divisional Orders by "G." (this is as a rule very short).

(9) *In making rough maps or plans* :—

(*a*) Put in the true North Point, on the right side.

(*b*) Underneath put in the Scale (by drawing and words).

(*c*) Also the conventional signs used in the Map or Plan.

(*d*) *In Map*, put in the Divisional and Brigade Boundaries, and Medical Posts (location of *all* of them).

Otherwise only main roads, villages, railways and streams, just so much as to make your arrangements clear.

I am well aware that the above are very sketchy, but they can be elaborated by each future candidate.

To finish I will add a short mnemonic, as all medical students are fond of them (and we are certainly students here):—

A.D.M.S.

A .... Assistance to Field Ambulances.

D .... Distribution of Field Ambulances.
Dumps (stretchers, blankets, rations, water).
Discipline of R.A.M.C.

M .... Motor transport, cycles, etc.
Medical supplies.
Messages.

S .... Stretchers.
Splints.
Sanitary Section.
Staff (consult "G" and "Q").

The above can be added to *ad lib.*

Retired Medical Officers Setting up in Civil Medical Practice.

By ONE WHO HAS DONE SO.

"We thank you for your last Pay Certificate and beg to inform you that all pay and allowances up to date of your retirement have now been credited to you by us."

Such a letter is received by hundreds of officers yearly—a sad moment marking the end of a contract carried out well. Now they are free, but in the majority of cases only freed by circumstance, to look about for a new occupation and livelihood in life.

For the retired medical officer is now "up against it." His father worked hard and denied himself much to educate him—surely then it is up to him to do the same for his children, and give them a sporting start in life.

We retired medicals have much to help us in our quest for remunerative

work. No officer of any other branch is in such a strong and enviable position. We have our profession, striven hardly for as students, increased in value many times since, if we have not been drones, during our varied service, with its endless opportunities for gaining experience and knowledge.

It is assumed that our retired medical officer has received a gratuity or a pension (a portion of which he can commute) and that from £700 to £1,000 is available to start him. From death vacancies, or older men retiring, suitable practices are constantly in the market, though one may not hit on the ideal all in a moment.

Now how to set about getting quickly into civil work.

First study the *British Medical Journal*. There will be seen the names of some six medical agents, all reputable, reliable and helpful to a degree. They will charge no fee as they receive that from the vendor. After a talk with one of these, our friend will be able to simplify the question as to which field of work is most suited to his circumstances, tastes, financial possibilities. Once this is done things will get going.

The agent will want to know what capital the purchaser can invest, whether practice in town or country is desired, and in what district. Let us suppose his wishes point to starting as a half or third share partner in an established town or city practice of say £1,200 to £1,500 a year. He would be asked to put down say £600 or £1,000, roughly. He would be introduced to the vendor, visit the practice and, if he liked the look of things, employ an accountant (3 guineas) to audit and verify the practice's receipts, expenses, etc. If further satisfied, opportunity would be given him to go and work at the practice for a month or more to see if it was as described. If finally satisfied, he concludes the bargain.

Another plan for one with moderate finance is to purchase a share in a city practice in a poorer quarter, with a surgery probably at some distance from the more prosperous residential quarter where he will live. This humbler practice he will visit at set hours morning and evening alternately with his partner, while for emergency calls to it he can be rung up from the surgery to his private house; thus the surgery will help to pay his way while he is "digging in" at his permanent address.

Information may reach one that a certain district or suburb is opening up greatly, and on examination it may prove an excellent policy to invest one's capital in a house in it and start off to build up a practice at once. This is all the more feasible nowadays, as one is likely to get patients at once under the Insurance Act.

Again, he may purchase an existing small practice in a town or suburb and run it on his own. In the writer's opinion at first, at all events, it is wiser and pleasanter to work with a partner. One has more freedom and more time for leisure or for one's other activities.

As to seeking a country practice much the same procedure holds good. Deciding factors will be largely the tastes of the doctor and his wife. Are they to choose country life and its delights, or the more busy and, to many natures, the more congenial, interesting life in town or city?

A large number of ex-service medical men have set up in town and country practices of late years, and those heard of are getting along and are well content.

Should capital be very restricted there is no reason why a man willing to work should be idle. Through agents he can obtain an assistancy till he sees his way clearer.

Insurance Practice.

There is no branch of medical work which brings credit and practice more rapidly to a doctor setting up than work under the National Insurance scheme. Let it be understood at once that there is no difference in this work from any professional work a doctor undertakes. It calls for the exercise of the highest degree of experience and skill. Added to this it is educative to a degree, while from a business point of view it repays one generously. Skill, consideration, kindliness to the insured men and women soon make the new doctor's reputation, and the uninsured members of the families come as private patients.

Many of the very ablest practitioners in our cities and country districts include a panel in their practice.

To the lot of a few retired medical officers comes a chance of setting up at once as consultants. There are men who, as Specialists in the Services took advantage of the exceptional opportunities offered them, and by hard work, research, etc., established high reputations in their branch of work. There are a dozen of such in London alone practising chiefly in tropical diseases, ophthalmology, fractures and deformities, throat, nose and ear and dietetics. Men with leanings towards public health work can try for posts of assistant M.O.H. of counties. Several have succeeded in this lately.

As this article threatens to become tedious let me sum up.

You want an income and work. Believe me, patients are only too glad and grateful to find doctors who are courteous, sympathetic and capable. The work is hard, but not unduly so. It is full of interest, and the zest of the fight to succeed is just fine. So get going. Have confidence in yourself; you have been up against many harder propositions.

Thank, but heed not, the friends who say "You have been in the Service so long you will never be able to take to or understand civil practice." Interesting statement, but happily quite untrue. There is no difference whatever in the work worth talking about. To make up for any supposed handicap in being able to run a civil practice the retired medical officer can bring to bear qualities developed in his Service work, thoroughness of examination, self-reliance, powers of improvisation, courtesy, and, perhaps above all, method. So have no qualms. Get hold of a little of the Coué spirit. You will enjoy the fight and succeed.

Ex-Service medical officers who have had experience of setting up in civil practice would be glad to give information to officers desirous of starting. Touch could readily be established between them through our splendid and practical correspondence circle.

Clinical and other Notes.

GLYCERINE AS A PRESERVATIVE FOR DIAGNOSTIC SERA.

By Captain J. M. MACFIE, M.C., R.A.M.C.
From the Vaccine Department, Royal Army Medical College.

For the supply of laboratories in Home Commands, and all Commands abroad, except in India, the following diagnostic agglutinating sera are made in the Vaccine Department of the Royal Army Medical College :—

Bacillus typhosus.
B. paratyphosus A, B, and C.
B. aertrycke "Newport" and "Mutton."
B. enteritidis Gaertner.
B. dysenteriæ Flexner V, W, X, Y, Z, and polyvalent serum prepared with these types.
B. dysenteriæ Shiga.
Vibrio choleræ.
Micrococcus melitensis.
M. paramelitensis.
Meningococcus (Types I, II, III and IV).
Pneumococcus (Types I, II and III).

Monospecific sera are also made, by absorption of an ordinary specific serum with the group phase of an allied type, as described by Sir Frederick Andrews [1], for *B. paratyphosus* B and C, and for *B. aertrycke* "Newport" and "Mutton."

In the preparation of these sera, the preservative at present employed is phenol in the proportion of approximately 0·5 per cent, obtained by adding to the serum eight per cent of a six per cent solution. This antiseptic, whilst useful in conserving the sterility of the serum, has certain disadvantages, which appear to be most marked when the sera are stored for prolonged periods under tropical conditions, the most important being the loss in titre which occurs, and which appears to be due to the precipitation of globulin. In addition, sera preserved in this manner become discoloured, opaque, and unsuitable for serological work.

The experiments here described were commenced in October, 1924, at the suggestion of Lieutenant-Colonel H. Marrian Perry, to contrast the preservative qualities of glycerine in various dilutions and phenol, and to ascertain the advisability of substituting glycerine as a routine preservative agent.

Method.—Agglutinating sera were prepared from rabbits against *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, *B. dysenteriæ* Flexner X, *B. dysenteriæ* Flexner Z, and *B. aertrycke* "Mutton."

The titre of these sera against stock laboratory emulsions of the homologous organism was determined.

For the six sera, five cubic centimetres of each of the following dilutions were then made up.

Number 1.—Serum 50 per cent, glycerine 50 per cent.

Number 2.—Serum 75 per cent, glycerine 25 per cent.

Number 3.—Serum 90 per cent, glycerine 10 per cent.

Number 4.—Serum 50 per cent, normal saline 50 per cent.

Number 5.—Serum 92 per cent, 6 per cent phenol 8 per cent.

The dilutions were made in sterile test-tubes and under sterile conditions, and the glycerine used was steamed for twenty minutes on three successive days before use. The test-tubes were plugged with cotton wool and covered with a rubber cap to prevent evaporation.

In all the agglutination tests which followed serum was obtained from the tubes under ordinary working conditions, i.e., the Dreyer pipette used was boiled in distilled water and passed through the flame before being dipped into the serum, and the mouth of the containing tube was flamed after opening and before closing. The same stock agglutinable emulsions kept in a cool dark place were used throughout the tests, except in one case (*B. paratyphosus* B), where it became contaminated, and had to be replaced soon after the commencement of the experiment. These emulsions were not re-standardized during the test, as it has been found that, when kept at room temperature, their sensitivity to agglutination remains stable for considerable periods [2]. Dreyer's technique was used throughout in putting up the agglutination tests and in determining the titre [3].

On the day following the addition of the glycerine, phenol, and saline, the titre of each dilution of each serum was determined, and at intervals varying from a fortnight to a month during the ensuing six months. During the first fortnight or so the sera were kept in cold store. They were then placed for two days in the 37° C. incubator to determine whether the sudden rise in temperature had any immediate effect on their titre. Subsequently they were stored for approximately a month at room temperature, after which they were placed in the 37° C. incubator until the end of the experiment. The sera were subjected to these changes in temperatures with the object of simulating as far as possible the conditions under which they might be stored in foreign stations.

The conclusions arrived at are as follows:—

(1) In all cases Numbers 3 and 4, i.e., the ten per cent glycerine dilution and the fifty per cent saline control soon showed signs of contamination. They became opaque, contained varying degrees of deposit, and acquired a marked discoloration—green at first, changing later to various shades of dark brown. Their titre fell rapidly.

(2) Numbers 1, 2, and 5, i.e., the 50 per cent glycerine, the 25 per cent glycerine, and the 0·5 per cent phenol all maintained their titre to about

the same proportions during the period of the experiment, and in this connexion it was interesting to find them maintaining their titre so well under somewhat adverse conditions. A *B. paratyphosus* C serum made up with fifty per cent glycerine by Captain H. J. Bensted, M.C., R.A.M.C., twelve months ago, and kept in a 37° C. incubator ever since, has maintained a titre of 1/5,000 during this period.

(3) Number 2 in all cases showed a small amount of deposit after a short time in the incubator, number 1 remained crystal clear with a very slight deposit, and number 5 became slightly cloudy with some sedimentation at the bottom of the tubes. The twenty-five per cent glycerine serum would therefore seem to show no great advantage over the 0·5 per cent phenol in maintaining its clarity. The fifty per cent glycerine serum has the advantage of remaining crystal clear and would not evaporate so quickly as the phenolized serum. The addition of glycerine to such an extent has the failing of lowering the titre to half by simple dilution, but this is no practical disadvantage in working with high titre sera. The addition of glycerine did not in itself seem to have any effect in varying the titre of the sera.

The following tables show the varying titre in two of the six sera upon which the observations have been made, and the charts show in graphic form the results reduced to terms of undiluted serum. The figures for the charts were obtained by multiplying the titres of numbers 1 and 4 by 2, of number 2 by $\frac{4}{3}$, of number 3 by $\frac{10}{9}$, and of number 5 by $\frac{100}{92}$. This multiplication increases the working error in reading the results of agglutination in some sera more than in others, but, provided that this disadvantage is borne in mind, it should not be sufficient to vitiate the graphic comparison of the results obtained.

TABLE 1.

No. 2.—*B. paratyphosus* B. ORIGINAL TITRE OF SERUM, NOVEMBER 19, 1924. T — : $\frac{1}{25000}$
tr. : $\frac{1}{50000}$

Serum dilutions	Titre 20.11.24	28.11.24	* 10.12.24	12.1.25	27.1.25	18.2.25	11.3.25	24.3.25	14.4.25	1.5.25	16.5.25	2.6.25
1	S 25000	S 25000	S — 50000	S 25000	S 10000	S 12500	S + 5000	S + 5000	S + 12500	S — 12500	S — 12500	S + 5000
2	S + 25000	S + 25000	S 50000	S + 25000	S — 25000	S 25000	S + 12500	S + 12500	S + 12500	S 12500	S + 12500	S 12500
3	S + 25000	S + 25000	S + 50000	S + 25000	S 10000	S + 5000	S + 2500	S 2500	T — 1250	S 1250	S 500	S — 500
4	S 25000	S 25000	S — 50000	S — 25000	S — 5000	S + 1250	S 500	S + 250	S 250	S 125	tr. 125	tr. 125
5	S 50000	S 50000	S + 50000	T — 25000	S — 25000	S 25000	S 12500	S + 12500	S — 25000	S — 25000	S — 25000	S — 25000

* The apparent increase in titre of the serum dilutions evident in the titration made on December 10, 1924, is attributable to a bacterial contamination of the emulsion employed in the test.

TABLE II.

No. 3.—*B. typhosus.* Original Titre of Serum, November 26, 1924. S: $\frac{1}{25000}$

Serum dilutions	Titre 27.11.24	4.12.24	16.12.24	12.1.25	26.1.25	19.2.25	20.3.25	6.4.25	22.4.25	7.5.25	23.5.25	8.6.25
1	S 12500	S 12500	S – 12500	S 12500	S 12500	S – 12500	S 12500	S 12500	S 12500	S 12500	S 12500	S 12500
2	S + 12500	S + 12500	S + 12500	S + 12500	S + 12500	S + 12500	S – 25000	T – 12500	T – 12500	T – 12500	tr. 25000	tr. 25000
3	S 25000	S 25000	S – 25000	S – 25000	T – 5000	S 5000	S – 5000	S + 2500	S + 2500	S + 2500	S 2500	S 2500
4	S 12500	S 12500	S 12500	S 12500	S + 2500	S 2500	S 2500	S + 1250	S + 1250	S + 1250	S 1250	S 1250
5	S 25000	S – 25000	S – 25000	S – 25000	S – 25000	S 25000	S 25000	S 25000	S 25000	S – 25000	S 25000	S 25000

Serum No. 3: *B. typhosus.* Macroscopic Appearance.

		12.1.25		12.6.25
1. 50 per cent glycerine	..	Very clear ..	..	Very clear
2. 25 ,, ,,	..	Clear	..	Clear
3. 10 ,, ,,	..	Cloudy, some deposit	..	Opaque yellow, much deposit
4. 50 ,, saline	..	,, ,,	..	Clear yellow, much deposit
5. 0·5 ,, phenol	..	Clear, slight deposit	..	Fairly clear, slight deposit

Serum No. 1: *B. paratyphosus* B. Macroscopic Appearance.

		12.1.25		12.6.25
1. 50 per cent glycerine	..	Very clear ..	..	Very clear
2. 25 ,, ,,	..	Clear	..	Clear, slight deposit
3. 10 ,, ,,	..	Opaque green, some deposit		Opaque, dark brown
4. 50 ,, saline	..	,, ,, much deposit		Clear, much yellow deposit
5. 0·5 ,, phenol	..	Clear, slight deposit	..	Clear, some deposit

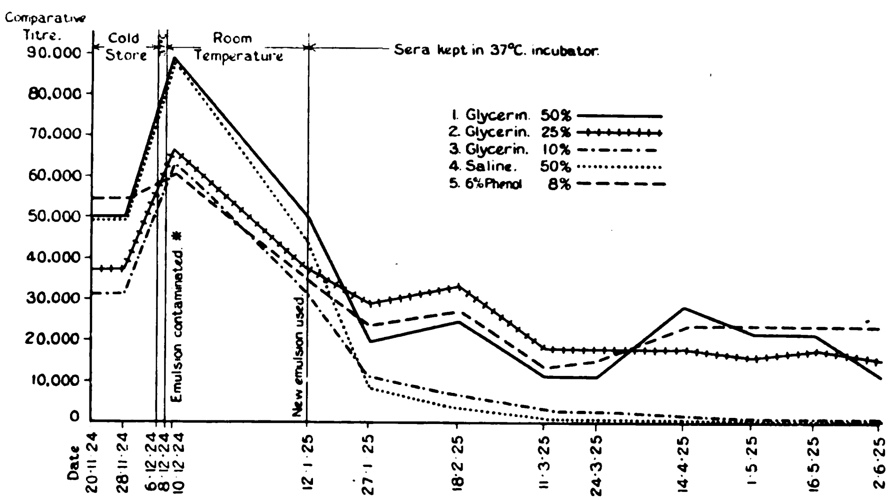


Chart I.—Serum No. 1: *B. paratyphosus* B.

* See note to Table I.

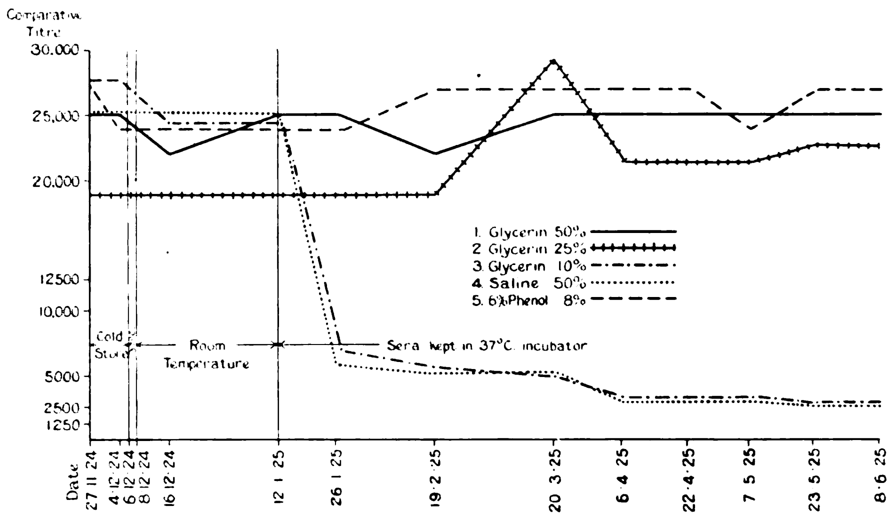


CHART II.—Serum No. 3: *B. typhosus.*

The macroscopic appearance of the two sera on two occasions during the experiment is also shown.

It will be noted that both series of results given are for sera prepared against organisms of the coarsely agglutinating, easily read type. The Flexner sera appeared to give results in no way different from sera of the typhoid-paratyphoid group, but, after storage in the incubator for some time, the type of agglutination they produced became very finely granular, making their end-point difficult to determine.

For suggestions and help during these experiments I am indebted to the experience of Lieutenant-Colonel H. Marrian Perry, O.B.E., Professor of Pathology, Royal Army Medical College, and to Captain H. J. Bensted, M.C., of the teaching staff.

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[3] Medical Research Council's Special Report Series, No. 51, p. 128.

TWO CASES OF LYMPHOCYTOSIS.

BY LIEUTENANT-COLONEL D. S. SKELTON, D.S.O.,
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CASE I.

IT is a question of some importance to determine to what extent (if any) and in which direction the blood of X-ray operators is affected by exposure to X-rays.

The case under review appears to confirm the belief that, in certain circumstances, a change may occur in the blood-picture.

The idea that X-rays may produce a change is not a new one. The deviation from the normal appears to affect the ratio between the polymorphonuclear element and the lymphocytes.

For instance, Amundsen, in a communication to *Acta Radiologica*, instances the cases of four X-ray workers and gives the following differential blood-counts :—

	Percentage	
	Polymorphs	Lymphocytes
Five years X-ray worker	41·0 ..	43·0
Two years X-ray worker	43·0 ..	51·0
Ten months X-ray worker	54·2 ..	43·3
Two months X-ray worker	57·0 ..	40·0

These counts appear to indicate a steady fall in the percentage of polymorphonuclears and a rise in the lymphocyte count, according to the length of time engaged on X-ray work.

The effects of light have recently been investigated by Leonard Hill and his co-workers. He gives in the *Journal of Experimental Pathology* (December, 1924) a summary of results obtained by other investigators, which may be quoted here.

The therapeutic action of light depends on changes in the epidermis and in the blood circulating in the skin exposed to radiation. Rollier, in the treatment of surgical tuberculosis by heliotherapy, finds that a good prognosis is accompanied by a lymphocytosis. Murphy and Storm have found that mice with a high lymphocyte count are resistant to the inoculation of tubercle bacilli. Janet Clarke's observations indicate that the effect of sunlight on the erythrocyte count is not very marked, whereas the white blood corpuscles, especially the lymphocytes, respond to short exposures of any radiation (sunlight, ultra-violet, X-rays and heat).

Leonard Hill concludes that all published results agree that ultra-violet light stimulates a lymphocytosis in men and animals.

He showed that when the shaved skin of a rabbit is exposed to sunlight, ultra-violet light or radiant heat, an enhanced power of killing the ordinary pyogenic cocci is acquired, and he concludes, as the result of his experiments, that light has an important effect on the leucocytes. The endothelial cell of the vessel wall appears to be involved.

* * * * *

Pte. O., R.A.M.C., an X-ray attendant at the Military Hospital, Tidworth, has been under my observation since September, 1923. The volume of X-ray work at Tidworth is not great, but, so far as I can ascertain, the operator is liable to short exposures to X-rays. Naturally, his switchboard, etc., is protected by the usual lead screen, but in order to effect adjustments to his apparatus from time to time he is obliged to submit to unscreened exposure.

His blood for a differential count has been drawn by a generous prick from the finger and a drop caught as it flowed, that is to say, without the application of any pressure. Every observation had been made at almost

the same hour, viz., 11 in the morning, say two and a half hours after the last meal. The percentage count is as follows:—

Date	Polymorphs	Lymphocytes
1.9.23	61·0	31·0
9.10.23	61·0	29·0
12.12.23	58·0	35·0
15.1.24	51·0	37·0
13.2.24	53 5	38·5
19.3.24	34·0	52·0
9.4.24	34·0	34·0
7.5.24	42·5	36·0
12.6.24	23·0	64·0
11.7.24	47·5	43·5
12.8.24	38·0	39·5
8.9.24	34·5	47·0
6.10.24	37·0	49·5
3.11.24	33·5	57·0
2.12.24	51·0	36·5
1.1.25	57·0	32·0

The other elements in the blood-picture have shown no great variation. The large mononuclear percentage has never exceeded 6·5 per cent. The August, 1924, count showed ten per cent of eosinophils, the average over the whole period having been five per cent. In the same month he showed mast cells 3·5 per cent, the usual figure having been 1 to 1·5 per cent.

The total count for both red and white cells has been approximately normal, as also has been the hæmoglobin percentage. At no time during the period has he complained of feeling ill or out of sorts. He has escaped the epidemics of influenza of January, 1924, and of January, 1925, during both of which there was a fairly high incidence of sickness in the station.

After his blood-count in December, 1924, he was taken off his X-ray work and put on to out-of-door work as a pioneer. The January count shows, it will be seen, a slight rise in the polynuclear element.

On February 10, 1925, one month after he had returned to duty in the X-ray Department, his blood-count gave a reading of polymorphs 48·5 per cent, lymphocytes 40·5 per cent.

On analysis of the counts, it is found that the small lymphocytes, over eighteen separate counts, average out at 23·5 per cent. The large lymphocytes, over the same eighteen counts, give an average of 15·3 per cent.

Stitt regards a normal percentage as being: Small lymphocytes, 20 to 30 per cent; large lymphocytes, 2 to 6 per cent.

In the case of Pte. O., therefore, there is found a deviation from the normal differential blood-count, and the change is evidenced by a relative fall in the number of polymorphonuclears and an increase in the lymphocytes, chiefly of the large variety.

Two further R.A.M.C. workers were examined, both of whom are employed in the Electro-therapeutic Department.

Serjt. H. gave a reading of: Polymorphs 60 per cent, large lymphocytes 9 per cent, and small lymphocytes 21 per cent.

Cpl. R. showed: Polymorphs 50·5 per cent, large lymphocytes 13·5 per cent, small lymphocytes 21·5 per cent.

These are the only counts that have been made on these two workers, but they will now be kept under monthly observation.

The problem, it seems to me, is not one that merely concerns the laboratory worker. It is not merely a question of academic interest. "All published results," Leonard Hill says, "agree that ultra-violet light stimulates a lymphocytosis in man and animals." This fact is undoubtedly made use of therapeutically to-day, but it seems to be commonly taken advantage of in the more serious diseases, such as lupus and malignant growths. I am told, however, that when a case of "boils" visits "Harley Street," X-rays are advised. The application of this agency is no small business, entailing the use of pastilles and a knowledge of dosage and numerous other factors, to which I, personally, confess complete ignorance. I plead here, however, for consideration of those cases of impetigo, acne and furunculosis which are so common in the Army, and which help so materially to fill our hospitals. The "skin" division of a hospital is almost a bane in the life of the pathologist who is asked to employ vaccine therapy. Stock vaccines, autogenous vaccines, sensitized vaccines, alike seem to have small effect on cases of long-standing acne which are so common in young soldiers.

I find in my records for last year that, in forty-three cases of impetigo and its allied conditions, I can only record a cure in eight following vaccine therapy. In eleven per cent of my cases vaccine therapy had no appreciable effect at all.

What I want now is to try exposing similar cases to some sort of radiant energy, and in this connexion perhaps some X-ray specialist will advise how this can be done most simply.

Suppose a patient gives a history of acne of the face or forehead of long standing, how can we best expose the affected part to X-rays? Can we, without damage, let him face a "soft" tube for, say, a quarter of a minute on alternate days for, say, a month without doing him any damage?

If we employed some measure of exposure to X-rays, plus vaccine therapy, plus manganese, should we obtain better results, the object being to produce a lymphocytosis and "an enhanced power of killing ordinary pyogenic cocci"?

* * * * *

Case II.

This case of lymphocytosis is rather one for diagnosis.

Miss S., aged 19, a pupil teacher, was sent to me by Major Lane, R.A.M.C., for a general blood examination. She had consulted him on account of some general debility. She complained chiefly of a certain, though not very pronounced, breathlessness on exertion, otherwise there were no marked symptoms. She appeared slightly pale and anæmic.

The organs were healthy. Spleen was not enlarged; there was no adenitis and no history of hæmorrhage. Menstrual history was quite normal. She was well enough to carry on her work.

On October 15, 1923, the erythrocyte count was approximately 4 millions, white corpuscles 8,000 per c.mm., and hæmoglobin 75 per cent.

The differential blood-count made on that date seemed to me so abnormal that I sent a slide to the Royal Army Medical College, where Lieutenant-Colonel H. M. Perry, O.B.E., had it checked for me. The count showed percentages:

Polymorphs	9
Large lymphocytes	78
Small lymphocytes	10

Other elements were normal.

Colonel Perry's advice was to watch the patient and carry out regular blood-counts. Iron and arsenic were therefore administered, and a blood-count was made each month, with the following results:—

Date	Polymorphs	Large lymphocytes	Small lymphocytes	Hæmoglobin
	Percentages			
15.9.23	9·0	78·0	10·0	75·0
3.10.23	30·5	46·5	11·5	80·0
3.1.24	23·5	35·0	34·5	90·0
7.2.24	43·0	22·0	25·0	90·0
3.3.24	51·5	15·5	28·5	90·0
1.4.24	56·0	22·0	17·0	85·0
1.5.24	61·0	16·0	20·0	—
1.7.24	50·0	15·0	30·0	80·0

After the last count she was advised to consult her medical officer only if she thought she was not going on well. At the end of her nine months' treatment she was distinctly better. She had a good colour and was able to take exercise without distress. In fact she was as well as she probably ever will be.

What is the exact diagnosis in this case? Colonel Perry was good enough to offer three suggestions:—

(1) Is this a case of lymphatic leukæmia? He thought not, as the red cell count was against it, and there was too little blood disturbance.

(2) Is it due to the film being taken soon after the ingestion of food, as a lymphocytosis occurs during digestion? To eliminate this error films were taken later in the morning, but the result was not altered to any appreciable extent.

(3) Is it a case of infective mononucleosis? (vide *Proc. Roy. Soc. Med.*, 1923, xvi (Sect. Med.), p. 70). In addition to Colonel Perry's suggestions a possible diagnosis of lymphoid pseudo-leukæmia might be made. But the possibility of the case being one of lymphatic leukæmia had to be very carefully considered. Clinically the evidence was against it. Leukæmia without glandular enlargement is rare. Osler mentions that twenty-two in his series of twenty-six cases had glandular enlargement.

It may be said that there are two forms of lymphatic leukæmia in which the pathologist is more particularly interested : the acute and the chronic. In the acute form the blood-picture shows an increase of the large lymphocytes, and in the chronic the small lymphocytes. In the case of Miss S. we have the initial increase affecting the large variety ; and we might therefore have expected the case to go downhill fairly rapidly, and once the disease starts on an unfavourable course it is astonishing how rapid the decline can be.

Still, cases do recover occasionally, and a chronic condition may persist for years. Osler quotes a case of ten years' duration in which a differential count gave 90 per cent of lymphocytes.

The absence of glandular enlargement would not appear to be a bar to the diagnosis of leukæmia. Cases have been recorded in which neither the spleen nor the lymphatic glands have shown signs of enlargement, and in such cases it has been suggested that the term "lymphatic" should refer to the dominant type of leucocytes present in the blood-picture rather than to their origin.

In lymphoid pseudo-leukæmia the white count lies between 5,000 and 10,000, with 75 per cent of lymphocytes; but in these cases there is a splenic enlargement and a tendency to hæmorrhage.

It has been thought worth while recording this case, if only because it affords an instance of how great a deviation from the normal can exist in the blood without producing any very serious symptoms.

My thanks are due to Colonel A. Chopping, C.B., C.M.G., for his permission to publish the notes on the cases recorded above.

Echoes of the Past.

SURGEON MAJOR BELLOSTE.

By Major OSKAR TEICHMAN, D.S.O., M.C.
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Augustin Belloste was born in Paris in the year 1654 ; he commenced the study of surgery at an early age, and, after qualifying as a sworn master-surgeon, held various posts in the hospitals of Paris.

Taking advantage of the temporary quiet which reigned in Europe after the peace of Nimeguem (1678), he travelled in Italy for some years, working in various hospitals. In 1686 he was appointed Surgeon Major to the hospitals of the Army of His Royal Highness the Duke of Savoy ; after the defeat of the latter by the French in 1689, at Saluces, under Marshal de Catinat, Belloste transferred to the French service, being appointed Surgeon Major to the hospitals of Louis XIV in Italy, and on the frontier of the Dauphiné. In 1697 when the Peace of Ryswick was signed, he left

the King's service and became senior surgeon to the household of the Duchess of Savoy, until her death in 1724. Belloste died at Turin in 1730, aged 76. He was a sound practitioner and although he did not make any striking innovations, he revived many excellent principles which had been forgotten, such as the too frequent dressing of wounds, the abuse of tents, the misuse of unguents, and the mercurial pill (originally invented by Renou) which bears his name.

In 1695 Belloste published his "Chirurgien d'hôpital, ou Manière de guérir promptement les plaies"; this ran into many editions and was translated into several languages. The frontispiece of this book depicts a bored-looking gentleman sitting upright in a chair, while the surgeon, after trepanning, is applying a dressing to the dura mater. The volume deals mainly with the abuse of tents, operation of trepanning, dressing of wounds, treatment of fractures, and the recitation of a large number of clinical surgical cases, in the treatment of which Belloste is always successful when others have failed. As many of these cases are not without interest, some of them, taken from a contemporary English version, are recounted below:—

A Wound of the Head.

After the war broke out in Savoy, there was brought to the King's Hospital at Lucerne, where I was then Surgeon Major, in July 1690, a soldier called La Grandeur, of the Regiment of Poudeux, which is now that of Gatinois, who had received a wound on the right side of the head with a pretty large bullet, which grazing upon the most convex part of the bone of the Sinciput, had only carried away the common teguments, not hurting the scull: but the membrane that invests it was so bruised, that it appeared livid. I know, if time had been given, it would have come to suppuration, whereupon the alteration and exfoliation of the bone must needs have ensued; to prevent which, I tore off with my nails the pericranium, so far as it was bruised, which was something more than the bigness of a shilling: and forthwith struck the uncovered bone in several places as nimbly as I could, with the pyramid of the trepan, and then covered it with some lint wet with spirit of wine. The rest of the dressing was charged with a simple digestive, upon which I put Emplastrum de Betonica, and above all the cap. After two days I took off the dressings, and found the bone covered with a lively red. Two days later it was drest as before, and then the bone was half covered over; so that in seven days' time the bone was quite covered with new flesh, which was instead of a membrane to it, and now nothing more was required, but by dressing it every other day, to attend the fall of the Eschar. Finally, in the space of eighteen days, the wound was filled up and compleatly cured.

A Wound of the Face.

Being in Pignerol in the year 1691, the Chevalier Vauban, a captain in the regiment of Beaujolois, sent for me to see his brother, who was run

with a sword into the cheek. The wound had been dressed by a surgeon, who at first thrust into it a tent, both thick and long, which passed into his mouth; and continuing the same method for six or seven days, the patient was thereby thrown into a violent fever, and his head and face were exceedingly swelled, by reason of the great flux of humours. After we had laid aside the tent, we found it necessary to have recourse to such means as might divert the humours, and by means of Sarcotics we compleated the cure, but an ugly scar remained behind, occasioned by the inconsiderate use of the tent.

Reflect.—The face being the image of God, and as it were an abridgement of all the beauties of nature, which as a little world representing in miniature what is more voluminously displayed in the great bulk of the vastly extended Universe, ought doubtless to enjoy some privilege over other parts of the body; hence it is all authors have condemned the use of tents in this part, Fabricius Ab Aquapendente, in wounds of the face, recommends the use of the dry stitch, to avoid the deformity of the scar. The saliva seems to be that balsam which is peculiar to the face, assigned thereto by nature, which has also granted to all other parts one proper to them.

A Wound of the Breast.

About the end of the year 1693, was brought to the King's Hospital at Briancon a Grenadier of the Regiment of Touraine. He was run into the side part of the breast, between the third and fourth ribs with a sword, which past into the capacity of the thorax and pierced the lung. The usual symptoms appeared at first and diversions were made. The first and second day some blood came from the wound, which was drest only with the plaister of Audreas à Croce, without either tent or dilater; Diureticks and diaphoreticks also were used, and upon the fourth day he voided abundances of urine, by which critical evacuation he was freed from fever, difficulty of breathing, weight upon the midriff, and spitting of blood; so on the fourteenth day he was compleately cured.

A Wound of Belly and Loins.

In the year 1688, a soldier of the Regiment of Montserrat called Sans Soucy, was wounded by a bullet, which entring before at the region of the navel, came out behind at that of the reins, piercing the right ureter. He was at first drest by one of the Master Surgeons at Turin, which he performed after his own way.

The orifice in the belly, notwithstanding the tents used, was closed up, after the falling off of the eschar; but it fared otherwise with that in the back; for that surgeon being careful to keep it open with a thick long tent, hindering also the reuniting of the ureter, which occasioned the urine to come forth in the wound. I having seen him one day, advised the surgeon to speedily remove the tent, if he would avoid an incurable fistula; but my words were to no purpose; for had he complied with them, he would have

thought he had offended against the rules of Art, and ancient received Maxims, with which my advice was inconsistent. Some days after, seeing this wound in a very bad condition, with dissolved caustick I consumed all that appeared callous about the lips of the wound, and leaving out the tent, I expected the discharge of what the caustic had mortified. When the flesh had resumed its normal colour, I syringed into the wound some Balsamick water. I also used the balsam of Peru for some days, and after that, the styptic plaister of Crollius, with longish compresses that was placed on the two sides of the wound, to press together the brims. Thus the wound began to be filled up, and the urine did by little and little resume its former course; and in about twenty days the wounded person was compleatly cured.

Of the Fundament.

Monsieur de Mourodon, Captain of a Battalion of the King's Regiment commanded by M. Desbordes, having been four years ago cured of an abscess in the anus, there remained still some fistulous sinus's, from which there was always discharged much matter. I proposed to lay open the fistula, but he calling to mind the torments he had endured in the first case, put it off for some time. About a month later the fistula opened with much matter and insupportable pain. I was at that time (1695) some distance from our hospital, and he caused himself to be drest by a Mate of the regiment, who used the common remedies, which made terrible corruption and havoc of the part. He then sent me an account of the deplorable condition to which he was reduced; begging me to come and see him. I found the matter that was retained, and the continual exasperation of the parts had made a hole big enough to admit one's fist, which passed with a winding course even to the os sacrum; there was also another sinus which reached to the neck of the bladder; so that the sick person could no ways go to stool, or enjoy one minute of repose. Having taken him under my care, I dressed him only with the Red Balsam with an equal quantity of Samaritan Balsam, which I poured warm into the sinus's; and covered the orifice with a pledget, plaister and compress. I caused him to use some absorbing medicines to dull the points of the acids, and Ptisans to purify the blood, and also some gentle purgatives. The method succeeded so well that the matter, which was thin, putrid and corrosive, became laudable. The flesh which was wan and wasted, by degrees recovered its firmness, and the patient went to stool without pain. Finally in a month's time he was compleatly cured, the sores being brought to a firm and laudable scar, to the amazement of the patient and his friends.

Of the Shoulder.

In the year 1678, as I travelled from Turin towards Rome and Venice, there was brought to me the son of an inhabitant of a certain place called La Rose, having an abscess that covered the acromium and upper part of the shoulder bone of the right side, with great defluxion of humours upon

the joint. I showed his father the great necessity of opening it, but the fond love he had for his son made him withstand the proposal. Some time afterwards the abscess burst in many places, into which tents were put by the surgeon. This was continued for three months without any prospect of a cure. He was then committed to my care, being deprived of the motion of his arm, having many cavities about the joint and relaxation of the ligaments.

I made a large opening in the most depending part, and took away the tents, tho' at that time I was not altogether convinced of their pernicious effects. The flux of matter began to diminish, and I cleansed the bottom of the sinus's with lotion of Birthworth, Myrrh, Sugar Candy and Vitriol in White Wine. Finally the cavities healed up, and he was cured in a month's time; but his arm was something more than other two, before it recovered its strength.

A Case of Complicated Fractures.

A soldier called La Violette of the regiment of Nevernois, and company of Bonal, was brought to the King's Hospital settled at the Abbey of Oulx on May 1, 1696. He had two wounds on the os sinciput of the right side, with the bone uncovered, all his face was bruised. Three of the upper ribs of the same side were forced inwards; his right arm was out of joint and the hand all torn; both his legs were shattered, the right one without a wound and the left with one; all which havock was caused by a fall from a very high rock, near the barrier of Fort D'exille. All his wounds were dressed but those of the head, which were not observed until the next day. His arm was reduced: his right leg which was broken about three fingers' breadth above the ankle was dressed with a circular bandage; the left leg with that of eighteen tails; the tibia was broken to pieces in the middle; and many of the splinters were out of their places. The wound bled indifferent much for four days, for I let the bleeding stay itself, without using astringents. I let him blood many times also because of the forcing in of the ribs, which occasioned a great difficulty in breathing. I caused a hole to be made in the straw bed and cloathes, which was sewed round, to afford him the conveniency of going to stool, without being removed.

The wounds of the head were soon healed without apparent exfoliation. The bruises of the face were removed; his ribs were restored by means of sticking plaisters; the dislocation of his arm, and the wounds of his hand gave us no trouble. The simple fracture, tho' the bone was shattered, was not followed by any accident. The wound of the compound one was compleatly healed in eight or nine days. After which we put little bolsters on the protruberant pieces of the shattered bone, tying them on with rollers, so that at the next dressing no irregularity was to be seen. About the fortieth day he was able to stand up with crutches; and his left leg, that had the complicated fracture, was stronger and more clever than the right, that had the simple one only; which was much admired by many.

Wound of the Arm.

In the year 1690, soon after the war was declared in Savoy, a soldier of the regiment of Pondeux, named La Montagu, was sent to the hospital at Briancon, who had got a violent blow of an halbert, on the middle and outer part of the left humerus, whereby the bone was broken to pieces, with a wound and great contusion. Several portions of the bone stuck out at the wound, which did still adhere to the periosteum. I placed them gently one by another, endeavouring to give them their natural position. I rubbed the part with a strong Balsam, very warm; I joined the lips of the wound and applied an incarnative. I gently rolled the part with a band about three fingers' breadth above the wound, and with another as much below it, applying a plaister made of Diapalma dissolved in oil of roses and vinegar; upon this I put a compress dipt in warm wine; then a piece of pasteboard which resting its ends on the two rollers, and embracing all the wound apparel, came together and was tied on the hinder part of the arm. In this pasteboard there was a hole cut out where it covered the wound, to which a piece of the same was fitted, to be taken off at each dressing; this was made fast with a band in such a way that the wound could be easily drest without disturbing the bone. In this manner it was drest once a day for six days. After which I drest but once in two days. The contusion was quickly dissolved; no bones were discharged and the suppuration was but little, and on the twenty-second day the wound was completely skinned, wherefore I thenceforth drest it only with rollers, plaister pro fracturis, and the necessary splents. Since then I have not seen him, because then we left Lucerne, but 'tis certain he was past all danger.

Belloste states that ruptures are frequent amongst soldiers, and that a truss is the most sure and infallible remedy to hinder the falling down of the guts; "But as there is no convenience for making trusses in hospitals, so accidents must be quickly provided for, that come oftentimes all of a sudden; such as descent of the intestine into the scrotum; for the pains are then extremely violent, and so grievous that they resemble those of the Passio Iliaca, wherefor on such an occasion I apply a cataplasm of Ox-Dung fried in Oil of Hempseed, or in that of violets. This remedy eases the pain by dispelling the wind, and so gives liberty to restore the gut into its place, provided the intestine is without excrementitious matter in it. With this remedy I have restored patients who seemed to be on the very brink of death. Moreover the Emplastrum pro Hernia ought to be applied upon the dilatation of the peritonaeum; but without a truss, the best of all remedies will do no great feats."

For arthritic conditions caused by soldiers lying on wet ground, Belloste condemns the use of a rope of flax applied round the joint and set on fire, "because it frightens the patient"; he recommends, instead,

a warm linement made of oil of Lavender, the fat of the Mountain rat and the Queen of Hungary's water. If, "happily an abscess forms," the bones should be restored into their cavity, and the joint fortified with man's grease applied hot: in the meantime the part being supported with a good bandage, and surrounded with compresses and bolsters, to command the bone and keep it fast in its place.

Belloste concludes his book with following apologia—" Such as impart to the Publick their observations and experiences, which are the fruit of their diligence and care, have deserved well of mankind. Many surgeons there are, who have not the advantage of occasions to accomplish themselves in this fort; and of those that have, few are so charitable as to publish what they've seen and remarked extraordinary. When a man does not communicate his attainments, by writing, to the Publick, let his endowments and knowledge be never so great, they are for the most part, if not altogether buried with him. The good a man can do lasts but for a time; but the excellent advice he leaves, in writing, to Posterity is useful for ever. We had still been in ignorance, had not the writing of the ancients come down to our hands. Wherefore, I felt myself bound in conscience, tho' at hazard of being condemned by the envious, to impart to the world my experiences, that, if possible, I might procure to poor wounded persons a more speedy assistance than can be afforded by the common method. If I shall have the happiness to succeed in my design, I shall feel myself sufficiently recompensed for all my toils, and will praise the Almighty Father of Lights, who by small means often brings mighty things to pass."

Current Literature.

Preservatives and Colouring Matters in Food. Final Report of the Departmental Committee on the use of Preservatives and Colouring Matters in Food. London: H.M. Stationery Office. 1924. 1s. 6d. net. Pp. 84. **Interim Report of the Food Preservatives Committee on the Treatment of Chilled Beef and other Foods with Formaldehyde.** London: H.M. Stationery Office. 1924. 2d. net. Pp. 11.—There has been considerable activity in the British Dominions and foreign countries in dealing specifically with preservatives and colouring matters by legislation. In many countries this consists of general prohibition of the sale of articles of food containing injurious substances, together with specific regulations relating to processes of preparations of articles of food. Every country which has legislated on the subject of preservatives prohibits the use of fluorides and formaldehyde.

Japan and certain of the United States of America are the only countries absolutely intolerant of preservatives of any kind in all foods, but the extent

to which they are limited in other foreign countries seems to indicate that the problem of keeping foods without resorting to chemical preservatives has not been generally found to be insoluble.

The term "preservative" does not include salt, saltpetre, sugar, vinegar, acetic acid, alcohol and spices or the minute quantity of preservative agents introduced by the process of curing known as "smoking," and does not include substances which, though they may have some preservative properties, are added to food for other than preservative purposes. The term does include, though, every other substance which when added to food has the property of preventing, arresting, delaying or masking fermentation or putrefaction of food.

Great Britain is in some ways peculiarly situated in that a large proportion of her food is imported and much of it from very long distances. The facilities for distribution, the provision of cold storage and cold transport are far less than in some other countries.

It is most unlikely that the effect of preservatives on the consumer would produce symptoms of acute poisoning, but any effect would be insidious and probably only noticeable after prolonged use; the poisonous symptoms would be difficult, if not impossible, to attribute with certainty to preservatives. The fact that a few large doses of a drug produce no ill effect does not prove that the drug will be equally harmless when administered regularly in small doses for prolonged periods. The question of idiosyncrasy of certain food preservatives must also be taken into consideration. The consumption of preservatives possessing cumulative action, such as boric acid, by persons suffering from renal inadequacy is certainly not free from danger.

Boracic acid is the most commonly used of all preservatives in this country, so that considerable quantities may be taken by the general public daily, and as a single dose is probably not completely excreted for five days, the tissues under such conditions are never free from boracic acid.

Benzoates are less toxic than salicylates and are as effective as a preservative; furthermore, salicylic acid is irritant to the stomach.

Formaldehyde is inimical to life and to vital processes of all kinds; it is a powerful protoplasmic poison. When ingested it exerts an irritant action on mucous membranes, and after prolonged use appears to cause inflammatory changes in the liver and also in the kidneys. In the body it is partly oxidized to formic acid and partly excreted unchanged; it combines with tissue proteins and is probably cumulative. It also combines with the protein constituents in foods, forming a compound which is less digestible than the original substance.

Sulphites may be regarded as amongst the less harmful preservatives. Sodium sulphite in the amounts employed in food has no specific toxic action, since it is rapidly converted into sulphate in the tissues. Nevertheless, it is not to be regarded as harmless, for if food which contains sulphites is taken daily, the SO_2 liberated in the stomach may cause dyspeptic

symptoms. Another objection applies particularly to its use in connexion with meat, the reason being that the putrefactive odour of decaying meat can be removed by treatment with sodium sulphite and the bright red fresh appearance restored.

For practical purposes it is possible to classify the preservatives into the following groups, according to their relative degree of undesirability, Group I being the most undesirable :—

Group I.—Formaldehyde and its derivatives : hydrofluoric acid, its salts and derivatives.

Group II.—Boron preservatives : salicylic acid and its salts.

Group III.—Benzoic acid, sulphurous acid and its salts.

If preservatives are to be used in foods at all, it is desirable that they should be confined, if possible, to those coming under Group III.

The use of substances in Group I no doubt occurs in isolated cases, but is rare. It has been suggested that the use of formaldehyde vapour in the Linley process for treating chilled beef for import should be permitted; it is recommended that it should be specifically prohibited.

The preservatives classified in Group II are in the commonest use. Boron preservatives are largely used in butter, cream, imported liquid eggs, margarine, sausages, potted meat, potted fish and some beverages; they are also used for packing bacons and hams.

Excessive amounts as 175, 140 and 110 grains per pound of boric acid have been found in margarine, butter and bacon respectively; it rarely amounts, though, to 35 grains per pound, or 0·5 per cent.

Salicylic acid and salicylates are found chiefly in beverages : beer, ginger beer and cordials and in some jams.

Benzoic acid is not at present used so extensively as salicylic acid, although the two substances possess in most non-alcoholic drinks and cordials practically equal powers of inhibiting fermentation and do not differ substantially in cost. No cogent reason for this common use of salicylic acid can be discovered.

Sulphurous acid and sulphites are extensively used in beer and alcoholic wines, and to a smaller extent in non-alcoholic beverages and in preserving fruits and fruit juices, dried fruits, gelatine and sausages. These preservatives are also commonly used by butchers, game and poultry dealers. In the case of beer, wines, fruit and fruit juices, the introduction comes partly from the treatment of the vessels of preparation and storage, partly from the materials used and partly from the actual addition of preservative in the course of manufacture or treatment for storage. In the treatment of meat in shops it is applied usually in the form of a wash on the surface of the meat. In sausages it is mixed with the other ingredients.

The addition of preservatives to milk is not necessary and there seems to be no sufficient reason why it should be necessary in the case of cream, provided suitable methods of transport, storage and distribution are made. It is recommended, therefore, that their use in cream should be prohibited.

Similarly, it is recommended that after a period of two years' grace, the addition of any preservatives to butter should be prohibited. The Australian and New Zealand trade, and possibly that of the Argentine, are the only cases where there might be difficulties, but from both the former countries a considerable amount of butter is already being sent without preservatives. As well-made margarine keeps fully as well as, or even better than butter, it is recommended that the addition of preservatives to margarine should also be prohibited.

Sausages are an important item of food in this country; large quantities are manufactured in well-equipped factories and have to be conveyed long distances before distribution. As, at present, there is a lack of suitable transport and storage accommodation, it is recommended that sulphurous acid, either in solution as such or combined as normal or acid sulphite, should be permitted to be added to sausages up to a maximum of not more than three grains, calculated as SO_2, per pound, and that no other preservatives be allowed.

The use of preservatives in the preparation, storage, or distribution of bacon and ham should be prohibited; similarly, the use of preservatives in brawn, potted meat, potted fish, pickles, sauces, lemon curd, mincemeat and jellies should be prohibited.

Owing to the importance of the maintenance of the fruit supplies of this country, it is desirable to permit the use of sulphurous acid in the preservation of fruit and fruit pulp for making jam, up to five grains of SO_2 per pound, but the finished jam should not contain more than 0·3 of a grain of SO_2 per pound.

As there are difficulties in keeping coffee extract, it is thought that three grains of benzoic acid per pound might be allowed.

Sulphur dioxide should be permitted in dried fruits, such as apricots, peaches, prunes, currants, raisins, figs, apples and pears, but not in amounts exceeding 0·1 per cent (seven grains per pound) of the dried fruit.

Large quantities of imported liquid eggs are now used by bakers in this country; if boracized and not frozen, they contain one per cent of boric acid, which means that a pound of sponge cake contains twenty-three grains of boric acid. The Committee have no hesitation in recommending that the use of preservatives in these eggs, used in the preparation of food, should be strictly prohibited.

With reference to beverages, it is recommended that preservatives should be permitted as follows:—

(*a*) Beer and cider: total quantity of sulphurous acid, free or combined, not to exceed five grains per gallon, expressed as SO_2.

(*b*) Alcoholic wines: sulphur dioxide, free or combined, not exceeding three grains per pint.

(*c*) Non-alcoholic wines, cordials, sweetened and unsweetened fruit juices: benzoic acid up to five grains, or sulphur dioxide up to three grains per pint.

(*d*) Sweetened mineral waters and brewed ginger beer: benzoic acid only up to one grain per pint.

Preservatives should therefore be prohibited in all articles of food and drink except that (*a*) sulphur dioxide should be permitted in sausages, jam, dried fruit, whole fruit or fruit pulp, beer, cider, alcoholic wines, non-alcoholic wines, cordials and fruit juices in quantities not exceeding those given above, and (*b*) benzoic acid should be permitted in coffee extract, non-alcoholic wines, cordials, fruit juices, sweetened mineral waters, and brewed ginger beer in amounts not exceeding those given above.

The methods of estimating sulphur dioxide and benzoic acid should be prescribed by the Ministry of Health.

It should be illegal to sell any preparation as a food preservative unless it bears a label clearly indicating its composition and strength, and unless it is free from impurities and containing not more than $\frac{1}{100}$th grain of arsenic per pound or $\frac{1}{7}$th grain of lead per pound.

The use of preservatives, so far as they are permitted, should be upon the condition that the nature and quantity of the preservative present in the article of food should be declared.

Improved methods in the storage and transport of food by rail, road and water are urgently required and will be secured by limiting and controlling the use of preservatives.

Apart from the use of copper salts for greening vegetables, which should be prohibited, colouring substances are used to a considerable extent in the preparation of foods, e.g., confectionery, sweetmeats, beverages, margarine, butter, biscuits, jam, jellies, custard powders and egg powders. They may be considered as falling into three groups: (1) pigments; (2) natural organic colour and caramel; and (3) synthetic organic compounds, chiefly of coal-tar origin, and frequently spoken of as aniline dyes.

It is recommended that the Ministry of Health should issue a schedule of colouring matters, the use of which is considered non-injurious to health, and the use of any other colouring matters should be prohibited.

It should be provided by law that any Regulations prohibiting or limiting the use of preservatives should bind the courts in proceedings taken under the Sale of Food and Drugs Acts in respect of their use; where a warranty defence is pleaded, an amendment of the law is required to render more expeditious the prosecution of a person actually responsible for offences under these Acts; local authorities should be given further powers of control in relation to all places concerned in the production, sale, storage and distribution of food.

Reviews.

GUIDE TO THE STUDY OF TSETSE-FLIES. By Professor R. Newstead, F.R.S., with the collaboration of A. M. Evans and W. H. Potts. London: Hodder and Stoughton, Ltd. University of Liverpool. Pp. xi + 332, 28 plates, 4 maps and 59 text figures. Price 20s. net.

This memoir deals in a comprehensive manner with the twenty species, one subspecies, and five varieties of *Glossina* recognized by the authors. Amongst these, *fuscipes* is placed as a subspecies of *G. palpalis* and *maculata* retained as a variety of this species.

The authors are to be congratulated on having kept to the straight path of entomology, resisting any temptation to wander into the Serbonian bog of the trypanosome controversy. After a very complete survey of the general structure and characters of tsetse-flies and their life cycle, each species is taken in turn and described in detail, together with an account of its known life history and general bionomics, distribution, the type of country favoured, and its natural enemies. The description of each species includes a complete account of the genital armature, on which structures Professor Newstead bases his specific grouping, and admirable drawings are reproduced depicting the morphology of the genital armature of every known species. In the introductory portion of the book these structures are described clearly with excellent illustrations so that a beginner who familiarizes himself with the preliminary explanation, will have little difficulty in understanding and appreciating the structural variation in these organs. The method of dissecting the armatures from dried and pinned specimens is described so clearly, step by step, that the veriest tyro who proceeds as directed should be able to produce a satisfactory preparation at his first attempt.

Amongst the many illustrations are included maps, showing the known distribution of every known species of *Glossina*; and a word of appreciation must be given to the bibliography containing several hundred references to the literature.

That this memoir will be valuable to the specialist goes without saying; but even the medical man interested in tsetse-flies who modestly "doesn't claim to be an entomologist" will find no difficulty in comprehending and appreciating the text, provided he commences at the beginning of the book. The few anatomical terms with which he may be unfamiliar are all explained by means of clear diagrams, and he will find no trace of that repellent Babylonish dialect which some of the learned affect to-day, as readily as did their prototypes in the time of the valiant Hudibras.

W. P. M.

A TEXTBOOK OF PHYSIOLOGY. By H. E. Roaf, M.D., D.Sc. London: Arnold and Co. 1924. Demy 8vo. Pp. viii + 605; 325 figures. Price 25s. net.

To men of an older generation it is always interesting to see a modern textbook upon a subject with which one is familiar, if only to note how much better or worse the younger people are catered for. We have here the latest textbook on physiology, and it must be admitted that it appeals because it deals with the subject in an unusual way. Dr. Roaf views the living body from the mechanical, chemical, regulative and reproductive aspects, and by that method initiates the student into the intricacies of the science of life. The scheme has much to recommend it and that is nowhere better shown than in the section dealing with bio-mechanics, which includes both the hæmodynamics of the circulation and the muscular mechanism of breathing, together with an explanation of the heat and electrical phenomena of muscle. In this section is a particularly good diagram showing the events of the cardiac cycle which appears to be quite original. We appreciate also the chapter on the dynamics of equilibrium and walking, which affords a welcome basis on which the young orthopædic surgeon may build his practical methods.

Excellent as is the book, we note some curious omissions and anomalies. For instance, why is there no reference to kinæsthesia or muscle sense, and why is a consideration of the lymph and the great part it plays in metabolism referred to a later place in the volume? Similarly, we find the functions of the cranial nerves somewhat superficially treated, while speech and the associated conditions of aphasia and agraphia are not adequately discussed. The outstanding features of the book are its originality of treating the subject, the excellence of the illustrations and its general lucidity. These are features which were conspicuously lacking in the older textbooks, and, with this volume available from which to learn, we shall have no sympathy or excuse for the student who fails to pass his examinations in physiology.

R. H. F.

THE MEDICAL WHO'S WHO. Seventh Edition. London: Grafton Publishing Company, Limited. Pp. lxiv and 770. Price 30s. net.

The last edition of this useful book of reference appeared in 1918, since when it fell into abeyance owing to the death of its then editor. It has now, 1925, been republished in an improved and more comprehensive form. The book differs from the medical directories in giving information as to date and place of birth, parentage and early education, and other matters, in addition to professional details.

The names are arranged in alphabetical order. It contains thousands of biographies, comprising not only those of prominent and representative physicians and surgeons, the nature of whose work is in many cases precisely stated, but also details of those members of the medical profession who rendered returns to the editor.

The volume contains no name that does not appear in the Medical Register, and the editors state that inclusion in the book is open to every registered medical practitioner.

At the end there is an alphabetical list of towns with the names of prominent resident practitioners. The editors and publishers deserve the support of the profession in the production of this useful and handy reference book.

THE MEDICAL ANNUAL, 1925. Bristol: J. Wright and Sons, Limited. London: Simpkin, Marshall, Hamilton, Kent and Co., Limited. 8vo. Pp. xcvi and 608. 149 figures, 43 plates. Price 20s.

Like its forty-two predecessors, the Medical Annual of 1925 gives a bird's-eye view of the progress made during the preceding year. It is intended primarily for the use of the practitioner, and is therefore concerned chiefly with treatment of disease. Twenty-eight contributors, all well-known authorities on their own subjects, have compiled this Annual, and officers of the Corps will be gratified to find among these authorities the name of Colonel L. W. Harrison, who has contributed the sections dealing with venereal diseases.

The book contains detailed information regarding advances in every branch of medical science, and it also suggests the more probable lines of further advances in contemporary medicine. Though 1924 will not rank as a remarkably progressive year, there is much new material in the book. The impression gained by the reader is that it indicates the consolidation of positions already won, together with the probable zones of further penetration into the unknown.

In an Annual of this nature members of the Royal Army Medical Corps will naturally look at the lists of references in order to find how much or how little has been extracted from this Journal, or from the writings of our officers in other periodicals. We are glad to note several references, including S. Smith's article on "Amœbiasis in Secunderabad," R. A. Mansell on the "Robertson's Treatment of Ringworm," Lomhelt on the "Danish Treatment of Scabies," and the work of A. T. Frost at the Royal Herbert Hospital, Woolwich. Reference is also made to N. Cantlie's work on the "Treatment of Malaria," published in the *Journal of Tropical Medicine and Hygiene.*

We officers of the Royal Army Medical Corps are serving in places where scientific observation of disease is possible, and this is what is wanted now. There is no reason why our observations should not be quoted and referred to throughout future editions of the book, if we care to record them to a greater extent than we do at present. In conclusion, we commend this invaluable book of reference to all who desire to keep up to date in the progress of the various branches of medical science.

M. B. H. R.

BILHARZIA. A PAPER FOR THE PRACTITIONER. By F. Gordon Cawston, M.D.Cantab. London: John Bale, Sons and Danielsson, Ltd. Price 2s. 6d. net.

This pamphlet contains some useful information on the vesical form of schistosomiasis, but is apparently written especially for use in South Africa, as only the local intermediate host, *Physopsis africana*, is mentioned.

The paragraphs on treatment should prove valuable to practitioners unacquainted with intravenous therapy, as the methods employed are described in detail. It is, however, questionable whether it is not preferable to add the tartar emetic direct to the boiled saline solution and not risk the possible alteration of this drug by boiling, as in the method suggested by the author. It will be found, in practice, that the unpleasant sequelæ described in the following paragraphs are then much less frequent in occurrence. The use of a small volume of diluting fluid is rightly insisted on, although the pain experienced when large quantities of fluid are used is not mentioned. The author suggests that a total course of fifteen to eighteen grains is generally sufficient to produce a permanent cure. While this may be so in lightly-infected Europeans, a much higher total is required in heavily-infected natives. J. B. Christopherson recommends a total of thirty grains, and experience has proved the wisdom of this.

The usefulness of this book could be much extended by including an account of the signs and symptoms of infection with *Schistosomiasis mansoni*. The morbid conditions produced by this species of blood-fluke being not only more diverse and often more difficult to elucidate, but much more serious in prognosis unless full and efficient treatment is carried out.

W. H. D.

LUMBAR PUNCTURE. By Professor Martin Pappenheim, M.D., Professor at the University of Vienna, Medical Superintendent of Neurological Department, Municipal Infirmary, Vienna. Translated by George Coffrey. London: John Bale, Sons and Danielsson, Ltd. 1925. Pp. viii + 248. Price 15s.

The book consists of twenty-one chapters, and contains an immense amount of practical information on this important subject. The publication is written with great detail, which makes it unusually lucid for those unacquainted with the technique of lumbar puncture and the examination of cerebrospinal fluid. The chapters dealing with the prognostic and diagnostic value and therapeutical application of the procedure are decidedly good.

An appendix on encephalography and puncture of the cisterna cerebello-medullaris is also given.

There are numerous references to German authors, and the volume, on account of the experience of the writer and his intimate knowledge of the work that has been done on this subject, should ensure its utility as a reference book. It is written in good English, clearly illustrated and well indexed.

W. F. M. L.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The Journal of the Royal Army Medical Corps is published monthly, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription for the Journal and Corps News Supplement is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

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Original Communications.

OBSERVATIONS ON THE EMPLOYMENT OF ANAEROBICALLY-GROWN *BACILLUS DYSENTERIÆ* SHIGA AS A VACCINE.

By BREVET LIEUTENANT-COLONEL H. MARRIAN PERRY
AND
MAJOR C. J. COPPINGER.
Royal Army Medical College.

VARIOUS attempts have been made from time to time in the Vaccine Department of the Royal Army Medical College to evolve a vaccine which might be prophylactically employed against bacillary dysentery [1] [2]. All of these efforts have been directed towards devising a method which would eliminate the severe local reaction following the inoculation of *Bacillus dysenteriæ* Shiga, and which would conserve the antigenic effects that might be assumed to result from its administration. It is not necessary to indicate the different methods adopted in these investigations, or the results which followed their application, as both are detailed in the papers to which reference is made. It will suffice to state in relation to these vaccines that the technique involved in their preparation was too cumbersome, or, more important still, the immunity response following their inoculation too insignificant to commend their employment on any large scale.

The importance, however, of securing an efficient vaccine prophylaxis against bacillary dysentery made it desirable to pursue any line of investigation which might lead to the production of a Shiga vaccine fulfilling the criteria necessary to justify its trial in an endemic area, namely, that no undue reaction, either local or general, should ensue from its inoculation into man, and that this should be followed by the production of demon-

strable signs of an immunity response in the blood of the inoculated individual.

Our attention in this connexion was directed to the work of McCartney and Olitsky [3] on the toxins of *B. dysenteriæ* Shiga, and it was suggested to us that an application of their method of separating the toxins of this organism might be utilized in the search for a vaccine which would fulfil the above criteria.

The work to which reference is made extended the previous researches of Olitsky and Kliger [4] on the nature of the toxins of the Shiga bacillus, and the following short *résumé* of these investigations may be conveniently given.

Olitsky and Kliger succeeded in demonstrating that in its process of growth *B. dysenteriæ* Shiga produced two toxins, an exotoxin and an endotoxin, which could be shown to possess distinct physical and biochemical properties. The exotoxin is moderately readily destroyed by heat and, on inoculation into rabbits, has a special affinity for the nervous tissues of the animal, producing definite and characteristic lesions in either the spinal cord or the medulla, or in both. The endotoxin, on the other hand, is relatively thermo-stabile, and, on inoculation, exercises its toxic effects on the intestinal tract, especially the large intestine, causing œdema, hæmorrhages, or necrosis of the mucous membrane.

The method employed in the production of the exotoxin was to culture the Shiga bacillus in a well-aerated fluid medium which was incubated for five days at 37° C. and at the end of this period filtered through a Berkefeld "N" candle. The filtrate contained the soluble exotoxin. Rabbits inoculated with this filtrate developed varying grades of lesions of the central nervous system, hæmorrhagic or necrotic areas, perivascular round-celled infiltrations, or chromatolysis and degeneration of the neurons, but failed to exhibit any involvement of the intestinal tract. The toxicity of the filtrate was shown to be destroyed when it was heated to 75° C. for one hour, indicating the thermo-labile character of the exotoxin.

To obtain the endotoxin the organism was cultured on a solid medium; the resulting growth was suspended in saline and the suspension incubated at 37° C. for a few days to promote lysis and liberation of the intracellular toxins. It was then filtered through a Berkefeld candle, the filtrate containing the endotoxin. The effects following the intravenous inoculation of rabbits with this filtrate, whilst mainly referable to the intestinal tract, were also manifested on the nervous centres. The filtrate could thus be assumed to contain a proportion of exotoxin in addition to the endotoxic element. More complete separation of the toxins was attempted by heating the filtrate to 80° C. for one hour, thus inactivating the thermo-labile exotoxin. A similar result was attained by neutralization of the exotoxin by the addition to the filtrate of anti-exotoxic serum. Intravenous injection of rabbits with this purified endotoxin caused the development of intestinal lesions without the production of any obvious pathological changes in the central nervous tissues.

The subsequent work of McCartney and Olitsky showed that the production of exotoxin in cultures could be almost entirely suppressed by the relatively simple procedure of growing the bacillus under conditions of strict anaerobiosis. By intravenous inoculation of rabbits with suspensions in sodium carbonate solution of the centrifugalized deposit from anaerobically-grown cultures, intestinal lesions without nervous involvement could be produced.

In view of these researches it was considered that it would be of interest to determine the effects, both as regards antibody response and local reactions, of the subcutaneous administration of a vaccine prepared from anaerobic cultures of *B. dysenteriæ* Shiga, as it was possible that the severe cutaneous reactions which have precluded the use of the aerobically grown organism as a vaccine might be dependent upon the irritant effect of the exotoxin. The present communication is the outcome of these investigations.

At the outset it appeared desirable to repeat certain of the observations made by McCartney and Olitsky on the relative toxicity of aerobically and anaerobically-grown cultures of *B. dysenteriæ* Shiga. Bacillary suspensions and filtrates were, therefore, prepared from cultures grown under aerobic and anaerobic conditions. The strain of organism employed throughout the experiments was that used by the above observers, namely, "109," supplied through the kindness of Dr. McCartney.

The following technique was employed in the preparation of anaerobic cultures. Four successive preliminary subcultures in narrow tubes of glucose broth were made under a seal of liquid paraffin. A flask of glucose broth, of a reaction of pH. = 7.4, was placed, directly after sterilization, in a Bulloch's jar, and the oxygen was removed in the usual manner. After a period of twenty-four hours the flask was opened and inoculated from the fourth preliminary subculture. It was then replaced in the Bulloch's jar, which was rendered anaerobic, and stored in the cold for twenty-four hours so as to promote thorough absorption of oxygen before active growth of the organisms took place. Finally this anaerobic culture was incubated for twenty-four hours at 37° C.

Aerobic cultures were made in shallow layers of broth of similar reaction in Noguchi flasks which were incubated for three days with occasional agitation to increase aeration.

These aerobic and anaerobic cultures were then centrifugalized, and the supernatant broth filtered through Berkefeld candles and tested for sterility. The sedimented bacteria were washed with distilled water, re-centrifugalized and emulsified in one per cent. sodium carbonate solution, heated to 56° C. for half an hour and placed in the 37° C. incubator for twenty-four hours to promote autolysis. The bacterial content of these suspensions was estimated by the opacity method prior to heating, and, finally, the suspensions were diluted to a convenient strength and tested for sterility.

After the preliminary experiments on animals, and when it had been decided to make a more extended series of observations on its use as a vaccine, a supply of bacterial suspension was prepared in the above manner with the further addition of 0·5 per cent. phenol as a preservative.

Investigation of the Relative Toxicity of the Filtrates of Aerobically and Anaerobically Grown Cultures.

The results of intravenous inoculation of rabbits with various doses of the sterile filtrates are given in Table I.

TABLE I.—Experimental Inoculation of Rabbits with Sterile Filtrates of Broth Cultures of *B. dysenteriæ* Shiga grown under Aerobic and Anaerobic Conditions.

Rabbit No.	Rabbit Weight	Dose c.c.	Result
Aerobic—			
569	2,300	2·0	Died in 2 hours.
579	1,950	1·0	Died in 60 hours.
578	2,150	0·5	Died in 36 hours; hæmorrhages in cord.
580	2,300	0·2	Died in 60 hours; gut œdematous; hæmorrhages in cord.
581	2,550	0·1	Survived; slight indisposition and loss of weight.
Anaerobic—			
570	2,450	2·0	Slight diarrhœa for 4 days.
577	1,950	1·0	No ill effects.

It will be obvious from the results of these experiments that the aerobic filtrate possessed a high degree of toxicity for the animals, and that its chief effects were confined to the central nervous system, whereas the anaerobic filtrate was of a relatively low degree of toxicity, and that the maximum dose given produced no nervous symptoms.

Investigation of the Relative Toxicity of the Autolysed Suspensions of Aerobically and Anaerobically Grown Bacilli.

Table II gives the results of intravenous inoculations of rabbits with various doses of aerobic and anaerobic autolysed suspensions.

TABLE II.—Experimental Inoculation of Rabbits with Washed, Autolysed *B. dysenteriæ* Shiga, cultivated under Aerobic and Anaerobic Conditions.

Rabbit No.	Rabbit Weight	Dose (millions)	Result
Aerobic—			
573	2,150	1,000	Survived; transient diarrhœa.
644	2,500	3,000	Died in 24 hours.
582	2,100	5,000	Died in 30 hours.
643	1,800	5,000	Died in 1 hour.
Anaerobic—			
574	1,850	1,000	Slight loss of weight only.
583	2,200	5,000	Slight indisposition and loss of weight.
587	2,400	10,000	No ill effects.
588	2,500	15,000	No ill effects.
589	2,400	20,000	Slight indisposition only.
590	2,500	40,000	No ill effects.
594	2,400	40,000	No ill effects.
598	2,350	50,000	Died in 12 hours; enteritis.
591	2,450	60,000	Died in 1½ hours.

The comparative toxicity of the autolysates is well illustrated in the above table. In the case of the aerobic autolysate the lethal dose lay

between 1,000 and 3,000 million organisms, and the animals which died as a result of the inoculation appeared to succumb to a profound toxæmia. Rabbit No. 644 showed some minute hæmorrhages in the cerebral cortex. The anaerobic autolysate, on the other hand, failed to kill with a dose of less than 50,000 million, whilst smaller doses caused either a transient indisposition or no ill effects. Rabbit No. 598 showed evidence of involvement of the intestinal tract, the small intestine being congested and its mucous membrane coated with a fibrinous exudate. In the case of Rabbit No. 591 the animal was convulsed before death, which was apparently due to anaphylactic shock.

The results of the above experiments accorded in the main with the findings of McCartney and Olitsky, and the freedom of the anaerobic autolysate from exotoxin was confirmed. Further investigation was, therefore, directed to the determination of the suitability of this autolysate for employment as a vaccine for subcutaneous injection, both as regards the reaction following its inoculation and its value as an antigen.

The fact that the agglutinative value of the serum of an animal immunized against *B. dysenteriæ* Shiga is a criterion of its protective value is noted by Flexner and Amoss [5] in comparing the sera of normal and immunized horses against the infectious or toxic effects of the bacillus. To ascertain if any evidence of this correlation could be obtained in connexion with agglutinin production following inoculation of the anaerobic autolysate, a rabbit, No. 590, which had been inoculated twenty-eight days previously with a dose of this *anaerobic* autolysate corresponding to 40,000 million organisms, was given 1,000 million of the *aerobic* autolysate intravenously, followed in twenty-four hours by a second inoculation of 5,000 million of the same. The animal survived and showed no ill-effects. It will be noted on reference to Table II that rabbits Nos. 582, 643 and 644, which were unprotected, rapidly succumbed when inoculated with similar doses of the aerobic autolysate.

Investigation of Local Reaction and Antibody Production in Rabbits following Inoculation of Anaerobic Autolysate.

(*a*) *Local Reactions.*—To determine whether any excessive local reaction would follow its administration, a rabbit, No. 599, was inoculated subcutaneously with an amount of the autolysate corresponding to 50,000 million organisms; a second dose, equivalent to 40,000 million, was given seven days later. No local reaction was demonstrable following the first inoculation, the second caused slight transient local induration.

(*b*) *Agglutinin Production.*—Observations on agglutinin production following the intravenous inoculation of the autolysate were made on certain of the animals which had been employed in determining its toxicity. The agglutinable emulsion used was a twenty-four hour formalinized broth culture of *B. dysenteriæ* Shiga, strain "109," and incubation was carried out at 55° C. for four and a half hours. This estimation was also made in

the case of the animal which had been inoculated subcutaneously, rabbit 599. The results of these agglutination tests are included in Table III.

TABLE III.

Rabbit No.	Dose (millions)	Agglutination titre in dilutions	Period after inoculation
574	1,000	125	21st day
587	10,000	300	8th ,,
588	15,000	300	8th ,,
589	20,000	200	8th ,,
599	*a*, 50,000 *b*, 40,000	25	13th ,,

The agglutinogenic value of the autolysate received further confirmation by the fact that repeated intravenous inoculations in the case of rabbit No. 574 raised its agglutination titre to a dilution of 1 in 2,500, an end-point comparable with that usually observed when immunization is carried out with aerobic cultures.

(*c*) *Complement Fixation.*—Definite deviation of complement was observed on testing the sera of rabbits, Nos. 587, 588, 589 and 594, amounting to three M.H.D. in the case of No. 588, and to between two and three M.H.D. in the case of the other animals. The antigen employed was a saline suspension of *B. dysenteriæ* Shiga, and control tests with the sera of three normal rabbits were uniformly negative.

The results of these animal experiments having shown that large doses of the anaerobic autolysate, given intravenously or subcutaneously, could be tolerated without undue reaction, and were capable of elaborating demonstrable antibodies for the Shiga bacillus, it appeared justifiable to investigate in man the reactions following its administration.

Investigation of Local and General Reaction and Agglutinin Production in Man following Inoculation of the Anaerobic Autolysate.

Experiment 1.—Pte. H. B. was inoculated subcutaneously in the deltoid region with a dose equivalent to 1,000 million organisms on May 14, 1924. Four hours later slight swelling and local tenderness were observed. On the following morning there was a pink areola around the site of inoculation, with some swelling and tenderness. By the third day all signs except a faint discoloration had disappeared. There was no constitutional disturbance. On the 20th May he received a second dose of 2,000 million, and on the 27th a third dose of 4,000 million. The reactions following these doses were no more marked than that noted after the first inoculation.

Agglutination results:—

Before inoculation	nil in 1 : 12·5
8th day	nil in 1 : 12·5
16th day	nil in 1 : 12·5
21st day	positive in 1 : 62·5
28th day	positive in 1 : 62·5
After seven months	positive in 1 : 50

Experiment 2.—Pte F. B. was given 2,500 million organisms on June 17, 1924. The local reaction was very much less marked than that following the inoculation of typhoid-paratyphoid vaccine, and had practically disappeared by the third day. There was no observable general reaction. A second dose of 5,000 million was given on the seventh day. The local reaction was somewhat more marked, but commenced to subside within forty-eight hours. A third dose of 10,000 million on the fourteenth day produced a slightly greater local reaction, the area of swelling being about six inches by four. Within five days all redness had disappeared, but a subcutaneous induration of about one and a half inches in diameter persisted for some days.

Agglutination results :—

7th day	Positive in 1 : 125
14th day	„ „ 1 : 625
21st day	„ „ 1 : 500
27th day	„ „ 1 : 250
After six months	„ „ 1 : 50

Experiment 3.—Pte. F. G. First dose, 5,000 million, on July 7, 1924. Local reaction mild, no general reaction. Second dose, seven days later, 10,000 million ; reaction again mild.

Agglutination results :—

7th day	Positive in 1 : 100
14th day	„ „ 1 : 250
After six months	„ „ 1 : 125

Experiment 4.—Pte. J. McD. First dose 10,000 million, on July 22, 1924. No general reaction; local reaction mild; all signs except slight induration disappeared by the fourth day. Second dose 20,000 million, nine days later. No general reaction; very mild local reaction, followed by an indurated nodule in the subcutaneous tissue.

Agglutination results :—

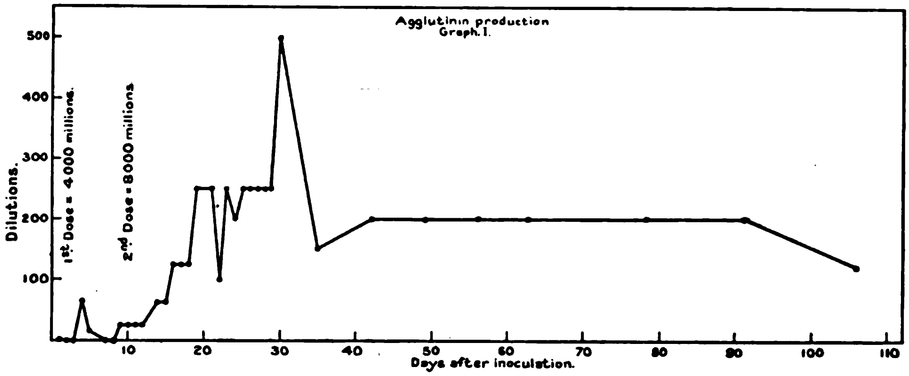
4th day	Positive in 1 : 125
8th day	„ „ 1 : 125
14th day	„ „ 1 : 125
After five and a half months.. ..	„ „ 1 : 50

At this stage the investigations were interrupted for a period of two months, and when they were resumed it was noted that the autolysed suspension which had been employed had become dark brown in colour and when tested by inoculation into a rabbit was found to have lost a considerable proportion of its toxicity. A fresh supply of washed anerobically-grown *B. dysenteriæ* Shiga was prepared and divided into two parts, one of which was suspended in carbolized one per cent. sodium carbonate solution and the other in carbolized normal saline solution. This procedure was followed as it seemed probable that the presence of free alkali might have accelerated chemical changes, and it was desirable to ascertain whether the omission of this constituent would affect the toxicity or antigenic properties of the suspension.

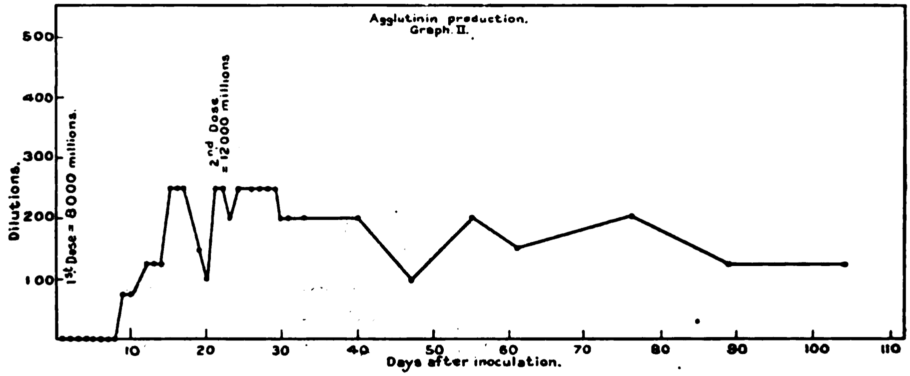
These two suspensions were tested on rabbits and both proved to be

somewhat more toxic than that prepared for the earlier experiments, but the saline suspension was not appreciably different in its effects from that containing the alkali.

Employing the carbolized saline suspension a further series of experiments on men were undertaken, and the progress of agglutinin production was observed more fully than in the previous cases.



Experiment 5.—A first dose of 4,000 million anaerobically-grown organisms suspended in carbol-saline was given to Pte. W. D. on October 13, 1924. There was no general reaction and the local effects were not marked. A second dose of 8,000 million was given ten days later and was not followed by any greater local reaction, but caused a slight



subcutaneous induration which persisted for fourteen days without giving rise to any inconvenience. General reaction was again absent. Agglutinin production was estimated daily for a period of thirty days and subsequently at longer periods.

Graph 1 illustrates the development of agglutinins in this experiment:—

Experiment 6.—Pte. W. A. received a first dose of 8,000 million of the same vaccine on October 15, 1924. This was followed by a definite general

reaction, with headache and shivering during the night and a temperature of 99·4° F. on the next morning. The local reaction was characterized by aching of the arm during the night and an area of inflammation about five inches long around the site of inoculation, with tenderness extending into the axilla. After forty-eight hours the constitutional symptoms had passed off, and the local inflammation was subsiding. By the fourth day all signs except slight induration had disappeared. The second dose of 12,000 million was given on the twenty-first day and produced a moderate local reaction with very slight general disturbance. Local induration persisted for about fourteen days, but caused no inconvenience. The development of agglutinins is shown in Graph II.

In view of the comparatively slight reactions following the inoculation of this suspension, its trial as a prophylactic vaccine in an endemic area of bacillary dysentery would appear to be justifiable. It is obvious, however, that any vaccine employed in prophylaxis against the group of organisms responsible for the disease should include the various serological types of the mannite-fermenting dysentery bacilli. A polyvalent vaccine was, therefore, prepared by the addition of representative strains of these organisms to the suspension of anaerobically-grown Shiga bacilli. The strains of mannite-fermenting organisms were cultured under ordinary aerobic conditions on agar for twenty-fours hours, the growths being emulsified in normal saline solution and the resulting suspensions sterilized by heating to 56° C. for three quarters of an hour.

The final constitution of the vaccine was as follows:—

Shiga (anaerobic)	10,000 million	per c.c.
Flexner "V"	100 ,,	
,, "W"	100 ,,	
,, "X"	100 ,,	
,, "Y"	100 ,,	
,, "Z"	100 ,,	

Experiment 7.—Pte. L. R. was inoculated subcutaneously in the deltoid region with 0·5 c.c. of this vaccine. A moderate local and general reaction resulted of about the same intensity as that following typhoid-paratyphoid inoculation. Symptoms of the general reaction passed off within forty-eight hours, and local signs had almost subsided by the third day.

A second dose of 1·0 c.c. was given on the nineteenth day, and was followed by a reaction somewhat less marked than that caused by the first dose.

Examination of the serum for agglutinins after each inoculation gave the following results:—

	After first inoculation (15th day)	After second inoculation (29th day)
Shiga	positive in 1 : 125	positive in 1 : 250
"V"	,, in 1 : 125	,, in 1 : 100
"W"	negative in 1 : 25	,, in 1 : 12·5
"X"	,, in 1 : 25	,, in 1 : 62·5
"Y"	positive in 1 : 125	,, in 1 : 100
"Z"	negative in 1 : 25	,, in 1 : 12·5

SUMMARY.

(1) Suspensions of *B. dysenteriæ* Shiga, cultured under anaerobic conditions, can be inoculated into man and animals in relatively large doses without the production of any excessive reaction, either local or general.

(2) The effect of such inoculations is to produce in the blood agglutinating and complement-fixing antibodies to an extent which is comparable with that following inoculation of Shiga bacilli, cultivated under ordinary aerobic conditions.

(3) There is some evidence to show that an animal inoculated with the suspension of anaerobically-grown organisms is capable of withstanding doses of a suspension of aerobically-grown bacilli which were fatal to unprotected animals.

(4) A mixed vaccine, consisting of bacilli of the mannite-fermenting dysentery group, together with anaerobically-grown Shiga bacilli, can be administered to men without causing a greater reaction than that following typhoid-paratyphoid inoculation, and produces demonstrable agglutinins for both types of organism.

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FURTHER INVESTIGATION INTO THE STERILIZATION OF WATER BY CHLORINE AND SOME OF ITS COMPOUNDS.

By Major C. H H. HAROLD.
Royal Army Medical Corps.

"There is no safe method of preventing water-borne diseases except sterilization of the liquid."
—Rideal.

(*Continued from p.* 207.)

Taste.

Houston [23] defines three tastes which may arise during the chlorination of water : (1) Chlorinous taste ; (2) iodoform taste ; (3) indeterminate taste. He notes that the iodoform taste is prone to arise in the presence of phenolic bodies (also *vide* Howard) [24] in deep well waters containing little oxidizable matter, and that small doses of chlorine favour the occurrence. This taste does not appear when superchlorination is adopted and can be removed by potassium permanganate. Up to last winter it was noticed at Sandhurst that an iodoform taste appeared regularly during the autumn. This water supply is drawn from a catchment area extending from Sandhurst towards Bagshot which is boggy in places. The water is obtained by percolation or seepage of surface water into herring-bone channels or leats, and on analysis gives a very high albuminoid ammonia figure (vegetable colloid). This increases during the fall of the year when the decay of vegetation occurs. The water is treated by bleach solution, passes through a Candy dechlor. filter and is then pumped to service reservoirs. This taste became so pronounced during the year 1922-23 that it became necessary to treat the water with potassium permanganate.

On visiting the source it was seen that certain subsidiary leats were choked and full of stagnating water which after rains gained access to the main channel. The main conduit or stream passed through a storage tank which by accident and not by design was acting as a sedimentation tank, and this had not been cleaned out or emptied for some considerable time; it was also noticed that road washings from certain rides might gain access to the water. The cleansing of the storage tank, the cutting out of certain leats and the diversion of roadside channels has apparently led to the elimination of this taste. If the taste had been due to the effect of chlorine on essential oils of decomposing algæ, etc., a recurrence would have been expected during the two succeeding autumns. A chlorinous taste, due to the over-chlorination, has occasionally arisen, but no complaints regarding the recurrence of the iodoform taste have been referred to us. The net result of the above operations has been a reduction in the amount of colloid in the water.

Since waters containing colloid in excess of the above can be safely chlorinated, and others containing relatively small amounts may develop

this taste if the incrimination of colloid is correct it would appear that the iodoform taste is qualitatively and not quantitatively connected with it.

Of interest are the beneficial effects produced by the chlorination prior to and following filtration as practised by Howard [25]. Here the vital filtering surface either holds up or modifies combinations tending to give rise to taste.

To obtain ammonia from colloid in the laboratory, it is necessary to expose it to strong oxidizing agents such as alkaline permanganate, etc.

Both the animal and vegetable kingdoms provide colloids (proteins) to which Cl_2 may become attached. These are composed of nitrogen containing molecules called amino-acids or amines. Bacteria, etc., may break down proteins to form phenolic bodies, indole, skatole and phenol. Hippuric acid is another benzene ring derivative usually excreted in urine. Chlorine may combine with amino-acids forming complex chloramines which have been accused of giving rise to tastes in water. As pointed out by Roaf [26] amino-acids are de-aminized by oxidation, i.e., become broken down, forming nitrogen and acids.

In the presence of colloids and their amino-acid derivatives, it appears feasible that a small dose of chlorine may attach itself to these groups forming complex chloramines with a distinctive taste. The exposure of these to oxygen in the form of permanganate should result in the de-aminization of the compounds and the disappearance of taste. With superchlorination, it is possible that chlorine, instead of attaching itself to the group, exerts a very effective oxidizing action (*via* nascent oxygen), resulting in the de-aminization of these bodies, and taste does not develop.

[27] Regarding iodoform tastes, occurring in deep well water—on examining Sir Alexander Houston's annual report for the year ending March 31, 1924, it is seen that the deep well incriminated is apparently Ferry Lance. Addendum A indicates that the water derived from this well gives one of the highest albuminoid ammonia figures. Addendum D bears this out. The comments passed by the Director of water examination on p. 31 are also interesting:—

> "Passing reference should be made in conclusion to (Y) Ferry stored water which during the period dealt with came from No. 4 Walthamstow storage reservoir. The results are a little puzzling as the ammoniacal nitrogen and the albuminoid nitrogen are higher than the raw River Lee water, and the results compare unfavourably with the East London aqueduct water."

Deep well water is drawn from depths devoid of oxygen and bacteria, and contained colloid would have little opportunity of being rapidly broken down to its ultimate products. Should the above theory be correct, after consumption of potassium permanganate the development of taste would be a natural sequence with a water containing small quantities of Cl_2 in the presence of disintegrating colloid.

Chlorinous Taste.—[28] Interesting information regarding this has been recently obtained in America by Warren and Bartow (*Journal of American Water Works Association*, Vol. II, No. 4, July, 1924). They demonstrate that taste and odour vary with the Cl_2 consumed figure which is an index of the oxidizable matter present—also that taste and odour may be developed by other oxidizing agents than Cl_2 and generally increase with the chlorine absorbed. Aeration may increase taste by further oxidation rather than remove it.

These results are in keeping with Sir Alexander Houston's experiences and expressions regarding potassium permanganate given on p. 46 of his report.

Indeterminate Taste.—An indeterminate taste is difficult to define. When this is not due to specific types of contamination it seems to possess certain definite characters. It may be described as a mawkish taste tending to develop into a faint iodoform taste. The finest example of this appeared in Birgand in East Persia. The water, an impounded surface and karez water with a high organic content was collected after the winter rains and conveyed by underground channels into a tank below ground level. Here in the absence of sunlight and fresh air it developed a taste reminiscent of the smell of a weak septic tank effluent. The tank and karez had the same smell. This water was used for domestic purposes in the hot weather during the shortage of sweet water.

The effect of chlorination upon it was indescribable, and after several years the recollection of the taste is sufficient to induce nausea. Heat accentuated the smell and taste, and tea made with this water was a beverage apart.

Regarding tastes due to simple chloramines, Race [29], who has considerable experience in the use of these bodies in water practice, does not mention the development of taste, and if troubles do arise he would undoubtedly have experienced it. During the last two years, no troubles *re* taste have been encountered at Aldershot. Waters treated with chloramines have a superior taste to waters containing equal amounts of free chlorine. Experiment and experience seem to indicate that there is less likelihood of taste troubles arising except when employing exceptional dosage possibly because the germicide is not absorbed readily and the chlorine is stabilized by attachment to a NH group.

The taste of the chloramines is distinctive and is a less pronounced taste than chlorine. In fairly strong concentration the combination of $Cl_2 : NH_3 :: 2 : 1$ gives rise to a dryish taste akin to peroxide of hydrogen with a faint after-taste. The taste of the combination $Cl_2 : NH_3 :: 4 : 1$ is more closely akin to chlorine.

The Absorption or Deviation of Cl_2 in Water.

It is realized that this has been the subject of considerable investigation and comment. Although the same general principles of purification are

applicable to civil and Army conditions, still from our point of view it is essential that the measures adopted should be capable of rendering every type of water innocuous in a matter of minutes. In military practice relatively large doses of Cl_2 in the form of bleach are used in the regimental water-cart (approximately 1 to $1\frac{1}{3}$ p.p.m. in excess of absorption). In the water sterilizing lorry, superchlorination with chlorine gas up to 10 p.p.m. is the normal practice followed by dechlorination with SO_2 and short contact periods of thirty minutes allowed. In civil practice a smaller dosage is usual, and the period of contact often indefinite. Obviously it cannot be expected that similar results will obtain in both cases.

It is frequently stated that the clarification of water under Army conditions leads to a reduced absorption of chlorine, that consequently the chlorine dose is proportionately affected, and all water duty men are instructed invariably to use clarified water for the Horrocks test. On one occasion, after this had been explained carefully to a class on the canal bank, the Horrocks test was carried out using clarified water from the cart. One member of the class took water direct from the extremely muddy canal full of weed. On the addition of indicator both results were identical and an explanation was requested.

Again, on another occasion, the Horrocks test against clarified canal water showed that 2 p.p.m. of chlorine was requisite as bleach to give 1 p.p.m. in excess of absorption. It was thought that the effect of clarification would be emphasized if an unclarified highly polluted water from a weedy off-shoot of the canal was used as a comparative test. This water showed that 1 p.p.m. of chlorine was an adequate dose.

It is generally agreed that the oxygen absorbed figure may give some indication regarding absorption of Cl_2, and the permanganate test, p. 89 [30], Metropolitan Water Board, Annual Report, presents interesting details. The ratios obtained by exposing raw unfiltered waters to the action of standard permanganate for five minutes and three hours are compared.

The raw River Thames water and filtered River Thames water gave the same ratios.

The raw New River water and the filtered New River water gave the same ratios.

The raw River Lea water shows a smaller chlorine comsumption ratio in three hours than the filtered River Lea water.

[31] A phase like reduction in the chlorine absorptive power of water with certain degrees of colloid pollution, was stressed in an earlier communication, and the River Lea figures above afford an interesting parallel.

From this it must not be deduced that the use of anything but clarified water for the Horrocks test is permitted, and it should be clearly understood that in the case of civil water practice using long contact periods, differences between the readings given by the clarified and unclarified water would be obtained. In addition it is not suggested that the bacterio-

logical results would be identical in both cases; as a matter of fact it is obvious that with unclarified waters containing large amounts of impurity, colloid, bacteria, etc., germicidal velocity is retarded and organisms would be alive and flourishing at the end of the half-hour contact, whereas in the case of clarified water they would be dead or greatly reduced in numbers.

The general experience of the school is that if samples derived from the same supply (clarified and unclarified) are put up together, it is the exception for any marked difference to be revealed by the Horrocks test.

The substances which affect absorption are usually divided into organic and inorganic groups. Many of the inorganic constituents being disintegrative products of the former.

From the military standpoint, deviation or absorption may be classified :—

(*a*) Immediate.
(*b*) Intermediate.
(*c*) Late.

(*a*) "Immediate" includes nitrites, easily oxidizable organic matter not affected by clarification, of which dilute fresh urine is an excellent example.

(*b*) "Intermediate"—ferrous salts and all colouring matter.

The first, and to a minor degree the second, are not affected by clarification and are present in all waters in this district, often in excessive amounts (Bourley basic carbonates) 0·02 to 1·4 per 100,000.

(*c*) Organic debris, decayed vegetable matter—mainly affected by clarification.

If reasonable care is exercised regarding selection of source of supply (*b*) and (*c*) give rise to little trouble, but under the influence of higher temperature or increased dosage of Cl_2 (*b*) and (*c*) tend to be raised into higher categories.

From our point of view the group which exercises the greatest influence is group (*a*).

In order to gain some knowledge of the relative merits of chlorine and chlorine ammonia compounds in the presence of oxidizable organic matter, etc., the following absorption experiments were carried out. To two gallons of ordinary upland water 200 c.c. of fresh urine was added, and absorption tests using the Horrocks test were carried out.

(1) *Chlorine.*—No chlorine left in any of the cups. Something well over 6 p.p.m. absorbed.

(2) *Chlorine Ammonia* (combination of equivalents).—Two parts per million absorbed.

When chlorine and ammonia equivalents interact a second titration fraction is frequently produced. Hence a water which by the Horrocks test may show a complete absence of free chlorine may still contain a latent second titration fraction which is exercising a germicidal effect. Its

presence can be demonstrated by the addition of acid. The water in the cups was acidulated, the first cup remained colourless, but the second cup gave the correct colour.

Consequently the amount of chlorine absorbed from equivalents of Cl_2 and NH_3 is one part per million only.

(3) *Comparison of absorption from a combination of equivalents of Cl_2 and NH_3 and from one equivalent of Cl_2 and half of NH_3 carried out as above.*—The series of cups containing equivalents showed complete absorption in cup one; cup two a faint blue colour. On acidulation the first cup remained colourless, and the second cup gave correct colour, again an absorption of one part per million.

In the series containing an equivalent of $Cl_2 + \frac{1}{2}$ equivalent of NH_3—all cups colourless—does this mean all chlorine deviated? On the addition of acid all cups gave a deep blue colour showing no absorption of Cl_2 from this combination.

The significance of the latent chlorine combination (second titration fraction) has been fully considered elsewhere, and also the second titration fraction appearing when chlorine is added to waters containing excess of ammonia as in sewage.

These absorption tests explain the experience of observers who have stated that in certain waters germicidal action has continued in the absence of free chlorine.

When using chlorine gas in waters containing large amounts of colloid or oxidizable matter the addition of acid will on occasions bring out a latent chlorine fraction. This is apparently due to the attachment of Cl_2 to colloid or other matter, and the germicidal activity of chlorine is not improved. (*Vide* tank experiments.)

The epitome appended contains experiments using waters with a high iron content (Bourley 0·16 to 1·4 p.p.m.) which demonstrate the adverse effect upon chlorine and the negligible absorption of chloramine.

Attention is particularly directed to the section dealing with ammonia and nitrites.

Colloids.

It has been demonstrated that colloids may retard the germicidal action of chlorine even when it is present in considerable amounts, consequently the reduction of these by our standard field measures becomes a matter of considerable importance. Ordinary water in which vegetable matter had been allowed to lyse, and in which mosquito larvæ had been reared, was found to give an albuminoid ammonia figure about 0·6 per 100,000. For the purpose of this investigation, water taken from the Basingstoke canal which had remained undisturbed throughout the winter was considered suitable. Water drawn with care from just below the surface without giving rise to disturbance gave an albuminoid NH_3 figure of 0·0248, and an O_2 absorbed figure in four hours of 0·1132. This water, after being pumped through the filter cloths of a regimental water-cart without using

alum in the box-heads, gave an albuminoid NH_3 figure of 0·0182, and O_2 absorbed figure 0·095 per 100,000. This shows an initial reduction of 25·6 per cent mainly strainable suspended colloid held up by the cloth.

Sedimentation of the raw water overnight with varying quantities of clarifying powder (as powder or solution) gave the best results; ten grains per gallon, giving a total colloid reduction of 61·3 per cent.

61·3 per cent total colloid—26·6 per cent strainable colloid—reduction of 34·7 per cent non-strainable colloid.

The next experiments were carried out after high winds, when the raw water gave an albuminoid NH_3 figure of 0·0372 and an O_2 absorbed figure of 0·2356. After pumping through the filter cloths of a regimental water cloth without using alum, this sample of water gave 0·0182 albuminoid NH_3 and 0·095 O_2 absorbed.

From these figures it appears that the amounts of non-strainable colloid are identical in each group.

When clarifying powder was used in the box-heads of the cylinders of the water-cart in the usual way a 66·1 reduction of total colloid resulted and a reduction of 30 per cent non-strainable colloid was effected.

The best results were obtained by the sedimentation of the raw water for twenty-four hours with ten grains of clarifying powder per gallon.

Raw water which had been strained by pumping through the filter cloths of a water-cart without using alum after further treatment with clarifying powder either in the form of powder or solution, gave inferior results as regards reduction of non-strainable colloid, and it appeared that the coarser particles strained off assist in the formation of an effective coagulum. There was little to choose between the water-cart and sedimentation tanks as regards reduction of non-strainable colloid, one giving a 30 per cent reduction and the other a 34·7 per cent reduction. From this it is evident that if on service water is drawn from sources of supply containing weeds, etc., capable of supporting the growth of mosquito larvæ, germicidal agents other than bleach and chlorine gas in ordinary concentrations require consideration if the delivery of a safe water within service time limits is to be ensured.

These results at first sight appear disappointing, but on comparing them with the New River or River Lee figures where sand filtration, a bio-physical and not a chemico-physical, process is used they appear satisfactory.

[32] New River gives a total reduction of alb. NH_3
from 0·0099 to 0·0048 = 51 per cent reduction
River Lee gives a total reduction of alb. NH_3
from 0·0142 to 0·0086 = 38 per cent reduction

The albuminoid ammonia figures indicate that the amount of colloid present in these supplies is very much less than in the Basingstoke canal and give a very good indication of the severity of the test to which our selected germicides have been put.

NATIVE AMMONIA AND NITRITES.

The effect of nitrites on chlorine is well known and has been previously commented on. Attention was redirected to this matter during a sterilizing trial with the regimental water-cart at Middlesex Wharf. Prior to taking a sample of Lee water, Major Elliott, who has considerable experience of the quality of this water, predicted that by the Horrocks test it would absorb 2 p.p.m. chlorine as bleach. However, quite unexpectedly it absorbed 5 p.p.m. as bleach and more than 6 p.p.m. as chlorine gas.

This large increase, and the difference between the hypochlorite and chlorine gas absorptions, appeared interesting.

At a later date two samples of Lee water were examined and were found to contain :—

(1)	Nitrites	2 p.p.m.
	Ammonia F. and S.	11 ,,
(2)	Nitrites	0·16 ,,
	Ammonia F. and S.	3·28 ,,

The second sample was put up as a Horrocks test against chlorine solution, bleach solution and chloramine.

Chloramine was unaffected
Bleach reading = 2nd cup
Chlorine solution = 3rd cup

Further experiments were then carried out in this connexion. First it was found that in ordinary waters the presence of ammonia appeared to fix the chlorine and inhibited absorption, and that the absorption from bleach was affected more easily than from chlorine gas.

Next, in waters containing nitrites in addition to ammonia. On one occasion water containing 1 p.p.m. of nitrites

Showed absorption from Cl_2 gas	=	3rd cup
from Bleach	=	1st ,,
from Chloramine	=	1st ,,

The addition of 2 p.p.m. of NH_3 to these

Changed absorption of Cl_2 gas	=	2nd cup
Bleach	=	1st ,,
Chloramine	=	1st ,,

On another occasion

Water containing 0·125 p.p.m. nitrites gave Cl_2	=	2nd cup
Bleach	=	2nd ,,
Chloramine	=	1st ,,

On addition of 2 p.p.m. of NH_3 this reading was converted to

Cl_2	=	1st cup (a trace absorbed)
Bleach	=	1st ,, (with no absorption)

Again, water containing 2 p.p.m. of nitrites :—

Cl_2	=	5th cup
Bleach	=	2nd ,,
Chloramine	=	1st ,,

The further addition of 2 p.p.m. of NH_3 gave a	Cl_2 reading	=	2nd cup
	Bleach	=	1st ,,
A further addition of 2 p.p.m.	Cl^-	=	1st ,,

Many further experiments were carried out, but the net result appeared :—

That when chloramines were produced by adequate contact of equivalents of Cl_2 and NH_3 or an equivalent of Cl_2 and $\frac{1}{2}$ an equivalent of NH_3 prior to dosage into water, they were unaffected by nitrites.

That the action of bleach in regard to nitrites was irregular.

That Cl_2 solution was regularly affected. Ammonia inhibits the oxidative action of Cl_2 in the presence of nitrites, bleach being more readily blocked.

In regard to germicidal velocity. When employing 1 p.p.m. of chlorine a concentration of ammonia of a half part per million is beneficial but with ratios in excess of this, although the whole of the available chlorine is conserved and is titratable in practically full amounts for days; the germicidal velocity is greatly reduced.

The presence of a large excess of ammonia influences the titration results and gives rise to a second titration fraction.

This second titration fraction combination is different from the fraction made by the interaction of a double equivalent of Cl_2 with an equivalent of ammonia and is not extracted from aqueous solution by CCl_4. It is seen to increase with the amount of NH_3 present.

Chloramines unlike chlorine act fairly expeditiously in the presence of excess ammonia ; in fact on occasions it appeared that the presence of 1 p.p.m. of NH_3 in the water treated by chloramine exercised a beneficial effect. Quantities in excess of this lead to prolonged conservation of the available chlorine, but again the germicidal velocity is impaired.

The effect of excess of ammonia on the titration figures of chloramine made by the interaction of equivalents of chlorine and ammonia is shown below. Water contained 10 p.p.m. of NH_3 to which has been added 1 p.p.m. as chloramine.

$$\text{Immediate titration} = \frac{0{\cdot}35 \quad 0{\cdot}35}{0{\cdot}7} \quad \text{after twenty-four hours} = \frac{0 \quad 0{\cdot}7}{0{\cdot}7}$$

This combination giving second titration fraction is also not extracted by CCl_4.

A Comparison of the Lethal Action of Chlorine—Chlorine and Ammonia (equivalents) and Cresol on Cyclops.

The presence of this crustacean in drinking water in India gives rise to occasional comment, and in view of the association with guinea worm is a matter of some importance.

It is known that cyclops [23] can only survive for a short time in water containing 0·25 to 0·5 per cent of caustic lime and 0·15 per cent of caustic potash, but if these waters are to be used for general purposes for long periods such additions call for further treatment.

Experimental Details.

A water heavily infested with cyclops and containing large amounts of organic debris was collected. After the removal of larger pond fauna and grosser particles of organic matter, 250 cubic centimetres of the water from the bottom of the bucket was added to two series of flasks containing an equal quantity of Bourley water.

Solutions of chlorine and chlorine ammonia (equivalents) containing 25 p.p.m. were prepared. It was anticipated that excessive loss of available chlorine would ensue owing to the abnormal character of the water and prolonged exposure of the solutions, but that a final titration on conclusion of the experiment would indicate the exact concentration present.

(*a*) *Chlorine* added to flasks to give the following theoretical concentrations in parts per million :—

	(1)	(2)	(3)	(5)	(8)	(10)	(15)	(20)
Titrations after 1 hour great loss by exposure and absorption	Not done				2·5 p.p.m.	4·5 p.p.m.	5 p.p.m.	8 p.p.m.

Mortality.—All alive after two hours.

(*b*) *Chlorine.*—A number of cyclops were transferred by means of a pipette to a concentration of chlorine containing 22 p.p.m.

Mortality.—

Half-hour	One hour	Two hours
All alive and lively but bleached	Majority very lively	All dead

Titration one hour equals 20 p.p.m. of chlorine.

(*c*) *Equivalents of* Cl_2 *and* NH_3.—Theoretical amounts of chlorine added in parts per million.

	(1)	(2)	(3)	(5)	(8)	(10)	(15)	(20)
Titrations 1 hour ..	—	—	—	2·9 p.p.m.	5 p.p.m.	6 p.p.m.	8 p.p.m.	9·5 p.p.m.

Mortality.—

	(1)	(2)	(3)	(5)	(8)*	(10)	(15)	(20)
10 minutes	—	—	—	—	Some sluggish		All dead but 3	All dead
20 minutes	—	—	—	Some sluggish		All dead but 1	All dead	—
40 minutes	—	—	—	Some sluggish		3 alive	1 alive	—
1 hour	—	—	—	1 alive		All dead		—
1¼ hours	—	—	—	All dead		—	—	—

* A culicine larva present but sluggish, and alive after 1¼ hours.

Result.—1/100,000 lethal in ten minutes. 1/300,000 in 1¼ hours.

(*d*) *Cresol*—Dilutions in clear upland water 1/10,000 and 1/100,000. Cyclops added to these as in (*c*).

Mortality.—Ten minutes 1/10,000 all dead. After several hours, 1/100,000 lively, all swimming about.

Conclusions.—Chlorine alone in 8 p.p.m. does not kill cyclops in two hours.

In 20 to 22 p.p.m. chlorine is lethal in two hours but not in one hour.

Chlorine and ammonia combinations (equivalents) are lethal in 2·9 p.p.m. (1/300,000) in 1¼ hours, and in 9·5 p.p.m. (1/100,000) in ten

minutes—a 1/200,000 concentration did not kill a culicine larva in 1½ hours. The sequence of death appeared to be (1) gravid females with large body area and egg sacs; (2) males; (3) nauplius larvæ.

Cresol.—R. W. coefficient 12 does not kill in a dilution of 1/100,000, but kills in 1/10,000 in ten minutes. In Macedonia it was found that cresol 1/100,000 killed mosquito larvæ in one hour; 1/10,000 killed mosquito larvæ in fifteen minutes [34].

The above indicates the selective action of these disinfectants. In view of the success obtained against cyclops with chlorine ammonia combinations, it is regretted that chlorine-resistant cercariæ and miracidia are not available for similar examination; also their effect on encysted pathogenic amœbæ seems worthy of attention.

Application to the Regimental Water-Cart.

The final undertaking was the application of chloramines to the regulation water-cart. This necessitated a simple method of production of standard chlorine solution. A specification was drawn up and submitted to Messrs. Sparklets, Ltd., who filled sparklet bulbs with chlorine gas and made valved dosing bottles, which have been in use for some time. The metal fittings of the dosing sparklet bottles are of Monel metal, which is acid-resisting.

Although these first bottles are experimental ones, they demonstrate clearly the possibilities of application. Profiting by the experience gained the evolution of improved patterns can be anticipated. The accuracy of dosage of bulbs with Cl_2 gas is remarkable, and the titration of solutions made from several of these reveals a negligible variation in content.

The success of this, the mechanical application, is mainly due to the good offices of D. H. Campbell, Esq., Works Manager of Messrs. Sparklets, Ltd., who has given the matter his personal attention. Following on this, attempts were made to devise a more convenient method of obtaining standard ammonia solution. The possibility of using a compound which could be handled, weighed and made up into a tablet, affords distinct advantages, and ammonium carbonate was first of all experimented with. Initial results were irregular and unsatisfactory until it was realized that ammonium carbonate, on keeping, gradually gives off a proportion of its ammonium content and becomes converted into hydrogen ammonium carbonate. In correction of this, an increase in the quantity of ammonium carbonate used yielded results comparable with those obtained with liquor ammoniæ.

At a later date, high concentrations of chloramine were obtained by the action of strong Cl_2 solution on appropriate quantities of ammonium salts. The attachment of the NH_3 group to an inorganic acid offers considerable resistance to the action of chlorine solution, permitting of the inter-action of strong solutions.

Addendum.

Apart from the utility of these compounds in the purification of water, their potentialities as germicides must not be overlooked. Wool soaked in a milk-white anthrax spore emulsion and dried is sterilized by immersion in a 1 in 340 solution of one of these in from three to six hours. This treatment, however, affects the character and properties of the wool. Still, with present-day chemical advances, this may not be an insuperable bar to successful application.

Again, the same compound is capable of preparation by unskilled hands in the presence of common salt. It is effective in association with colloid, and the solutions do not contain alkali to add to tissue irritation; consequently its behaviour in wounds, etc., merits at least a passing thought.

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EPITOME OF EXPERIMENTS.

Part I.—Cart Experiments.

Part II.—Tank and Laboratory Experiments.

Part I.—Cart Experiments.

Series A.—Indicates that flask technique cannot be relied upon with bulk supplies.

Series B.—Two-way tube experiments: Improved contact of NH_3 and Cl_2 solutions leads to the production of a second titration fraction and superior germicidal activity. Considerable loss of available chlorine is the rule.

Series C.—Taste and holding power of these combinations using two-way tubes in an upland water with a high iron content.

Series D.—Evolution of the pouring method showing its efficiency. Some irregular results appearing. (Experiment 3.)

Series E.—Treats of various combinations of chlorine and ammonia and the effect of adding chlorine to the cart first. Taste and titration results.

Series F.—Germicidal trials using crude and clarified canal water and the effect of adding the chlorine before the ammonia.

Series G.—Study of the effects of baffles on the diffusion of sterilants, proving that some of the previous irregular results are due to the inadequate mixing. A very important recommendation affecting the efficiency of sterilization of water in the cart is enunciated.

Series H.—Experiments carried out with carts in movement. The previous theories *re* adequate mixing corroborated.

Series I.—A comparison of the results obtained after making these chlorine ammonia compounds: (1) By simple pouring, (2) by contact of reagents outside the cart in ideal concentration.

Part II.—Tank and Laboratory Experiments.

In order to obtain more accurate information these experiments were carried out in tanks without baffles.

Series A.—The effects of pouring various ratios of Cl_2 and NH_3 into tanks.

Series B.—(*i*) The effects of the ammoniacal content of water upon these compounds; (*ii*) the effect of adding ammonia to water which has been chlorinated.

Series C.—Repetition of certain cart experiments under more favourable conditions, using various means of bringing chlorine into contact with ammonia and ammon. carb. General inference that a method of pouring gives very reasonable results under ordinary conditions.

Series D.—The influence of the various intervals when dosing NH_3 and Cl_2 upon the titration results.

Series E.—Attempts to evolve a method whereby stronger solutions of NH_3 and Cl_2 may be used, proving that the pouring method for this purpose has limited possibilities.

Series F.—Using ammon. carb. instead of NH_3, with and without ammonia in the water, also two-way tube trials with varying ratios of NH_3 and Cl_2.

Series G.—Continuing the attempts detailed in E above.

Series H.—Effects of excess ammonia in water on titration; results not very definite.

Series I.—Effect of prolonged contact of a stratum of Cl_2 with dilute ammonia.

Series J.—Germicidal activity.

(1) Comparison of the germicidal power of various compounds.
(2) Continuation of above.
(3) Continuation of above.
(4) Germicidal power of combinations produced by varying ratios of ammonia and chlorine.
(5) Continuation of (4).
(6) Influence of contact period of ammonia and chlorine in varying ratios.
(7) Continuation of above experiments.
(8) Continuation of above experiments.

Series K.—(*i*) Stability of chlorine ammonia combinations in natural waters; (*ii*) effects of heat.

Series L.—Indicating combining ratios of NH_3 and Cl_2. Experiments (2) to (5) ranging to obtain ideal concentrations of NH_3 and Cl_2.

Series M.—Effecting changes in titration results by varying methods of mixing and changing one combination to the other.
Series N.—Combining ratios and titrations in relation to solubility in CCl_4 and CS_2. The later experiments in this series take germicidal action also into consideration.
Series O.—Ammonia in water.
Series P.—The combined effect of nitrites and ammonia in water.
Series Q.—Manufacture of chlorine ammonia compounds from ammonium salts.
Series R.—The ammonium carbonate tablet.
Series S.—The chemical reactions.
Series T.—Details regarding experiments mentioned in the text.

Part I.

CART EXPERIMENTS.

Series A.

Water-cart Experiments :—

(1) Basingstoke Canal water—clarified by passage through reels of regimental water-cart—additional pollution load of 500 million *B. coli.*

Horrocks's Test : 3rd cup. Temperature of water 40° F.

Cart I.	Cart II.
1 p.p.m. Cl_2	½ p.p.m. of NH_3 added first, well mixed, allowed quarter-hour contact, followed by 1 p.p.m. Cl_2
Half-hour plating	
Negative	13 cols.

Result : Ammonization applied in this way is inferior to Cl_2.

(2) Repeated. Canal water through reels of regimental water-cart. No clarifying powder. 500 million *B. coli* added to water.

Mix in first ½ p.p.m. of NH_3 as above.
After 15 minutes 1 p.p.m. of Cl_2.
Half-hour platings : L. lactose agar. 3 cols.

Result : No improvement.

(3) Repeated above, allowing Cl_2 one hour's contact.

Platings negative, but *B. coli* MacConkey absent ½, 5, 10 c.c. ; present 25 c.c.

(4) Basingstoke Canal water through reels using clarifying powder.

Horrocks's Test : 3rd cup.
Try out against broth culture of *B. coli* 250 c.c. per cart, 24 hours' growth. (1,000 mils per c.c.).
Contact : three-quarters of an hour.

Cart I.	Cart II.
Cl_2 1 p.p.m.	NH_3 ⅓ p.p.m. added quarter hour before, followed by 1 p.p.m. of Cl_2
Platings : Coli ++++	Coli ++++

Ammonization leads to no marked improvement. After one and a half hours both waters contained 0·6 p.p.m. of Cl_2.

Remarks.—General inference that flask technique cannot be relied on with bulk supplies. Attempt to improve contact of Cl_2 and NH_3 by using a two-way tube.

Series B.

Cart Experiments using Two-way Tubes :—

Basingstoke Canal water. No clarifying powder in box head of cylinder. 250 c.c. broth culture = 250,000 mil organisms added to each cart.

(1) Solutions containing $\frac{1}{3}$ part NH_3 of same volume as Cl_2 solution. Both Cl_2 and NH_3 run in simultaneously through two-way tube.

		Cart I. Cl_2 and $\frac{1}{3}$ NH_3 Titrations	Platings	Cart II. Cl_2 only Titrations	Platings
1 hour	..	0·2 0·2 / Total 0·5	Half as heavy as Cart II	0·4 0·1 / 0·5	Enormous growth
2 hours	..	0·2 0·2 / 0·5	Growth lighter than Cart II	0·4 0·1 / 0·5	Growth lighter than above
3 ,,	..	0·25 0·25 / 0·5	About 100 cols.	0·35 0·15 / 0·45	,,
4 ,,	..	0·25 0·25 / 0·5	3 cols.	0·4 0·1 / 0·5	,,
5 ,,	..	0·25 0·25 / 0·5	Negative	0·4 0·1 / 0·5	Some thousands of discrete cols.

Improved contact has produced first and second titration fractions and a superior germicidal action, but there is considerable loss of available Cl_2.

(2) Repeated above—water badly discoloured owing to presence of oxidizing basic carbonates of iron.

Horrocks's Test: 3rd cup.

		Cl_2 and $\frac{1}{3}$ NH_3		Cl_2 alone	
1 hour	..	0·2 0·2 / 0·35	Thousands of cols.	0·8 0·3 / 1·1	Enormous film of growth
2 hours	..	0·15 0·15 / 0·3	About 100 cols.	0·8 0·2 / 1	Less than above
3 ,,	..	0·15 0·15 / 0·25	42 cols.	0·5 0·3 / 0·8	
4 ,,	..	..	13 cols.	0·5 0·3 / 0·8	Over 1,000 cols.
5 ,,	..	0·1 0·2 / 0·3	Negative	0·5 0·3 / 0·8	Over 100 cols.

Here again, although there is considerable loss of available Cl_2 with the two-way tube, still the combination of 1 Cl_2 + $\frac{1}{3}$ NH_3 is superior to chlorine alone.

(3) Canal water through reels; no clarifying powder. 500 million *B. coli* added as watery suspension. Not broth.

Test done in a snowstorm; unsatisfactory technique; solutions not poured simultaneously.

Horrocks' Test: 3rd cup.

		Cart I. 1 Cl_2 $\frac{1}{3}$ NH_3		Cart II. Cl_2	
10 minutes	..	0·35 0·2 / 0·5	210 cols.	0·4 0·1 / 0·4	Negative
½ hour	..	0·3 0·25 / 0·5	100 ,,	0·3 0·5 / 0·3	,,
¾ ,,	..	0·3 0·2 / 0·45	24 ,,	0·25 0·05 / 0·3	,,
1 ,,	..		10 ,,	0·25 0·0 / 0·2	,,
1½ hours	..		4 ,,		
2 ,,	..	0·25 0·25 / 0·5	Negative	0·2 0·5 / 0·25	,,
After 50 hours	..	0·1		0·0	

Cause of this delay not understood, except difficulties with pouring, etc. To be repeated in four days' time.

(4) Same as preceding, except previous day Bank Holiday. Canal used for boating and very muddy and stirred up. Water treated with clarifying powder in box heads. 500 million *B. coli* added (not broth culture).

	Cart I.		Cart II.	
20 minutes ..	0·20 0·45 / 0·65	Negative	0·1	Over 100 cols.
40 ,, ..	0·25 0·35 / 0·6	,,	0·1	151 ,,
60 ,, ..	0·25 0·25 / 0·5	,,	0·1	100 ,,
90 ,, ..		,,	0·1	50 ,,
120 ,, ..		,,	0·1	50 ,,

All Cl_2, except 0·1 p.p.m., has been absorbed and germicidal action is slow.

After two and a half hours, i.e., four and a half hours after dosing cart, re-contamination with 500 million *B. coli.*

	Cart I.		Cart II.	
60 minutes ..	Negative	0·2 0·2 / 0·45	Enormous growth	0·1
120 ,, ..	,,	0·2 0·2 / 0·4	,, ,,	0·1
180 ,, ..	,,		About 500 cols.	
240 ,, ..	,,	0·2 0·2 / 0·4	About 200 cols.	
After 24 hours..		0·15 0·1 / 0·25		

The superiority of chlorine-ammonia compounds is demonstrated.

Series C.

Taste and Holding Power Experiment and Methods of Application of NH_3 and Cl_2.

(1) Bourley water with high iron content. Varying from 0·12 to 1·4 parts per 100,000.

	Cart I. Cl_2 1 and NH_3 ⅜ p.p.m.		Cart II. Cl_2 1 p.p.m. only
10 minutes ..	0·225 0·375 / 0·6	.. ..	0·4 0·1 / 0·5
45 ,, ..	0·2 0·3 / 0·5	.. ..	0·4 0·1 / 0·5
1½ hours ..	0·2 0·3 / 0·5	.. ..	0·25 0·15 / 0·4
4 ,, ..	0·1 0·2 / 0·3	.. ..	0·0 0·1 / 0·1

Cl_2 has succumbed to absorption.

Opinion of 19 people drinking unknown samples.

Advantage of taste with $Cl_2 + NH_3$. Cl_2 smell and obvious taste, not so good. The chlorinous taste remained after four hours when only 0·1 p.p.m. could be detected.

Holding experiment: Bourley water loaded with iron.

(2) Comparison of holding powers of ¼ p.p.m. of NH_3 and ¾ p.p.m. NH_3. Volumes of NH_3 and Cl_2 solutions identical.

	Cart I. ¼ p.p.m. NH_3 and 1 Cl_2	Cart II. ¾ NH_3 and 1 Cl_2
After 50 minutes ..	$\frac{0{\cdot}1 \quad 0{\cdot}2}{0{\cdot}3}$	$\frac{0{\cdot}2 \quad 0{\cdot}25}{0{\cdot}4}$

Water dosed in this way with ¼ NH_3 and 1 Cl_2 tends to be deviated to a greater extent than ¾ NH_3 and 1 Cl_2.

Repeated:—

	Cart I. ¼ NH_3 1 Cl_2 p.p.m.	Cart II. ¾ NH_3 1 Cl_2 p.p.m.
After ½ hour ..	$\frac{0{\cdot}1 \quad 0{\cdot}15}{0{\cdot}2}$	$\frac{0{\cdot}25 \quad 0{\cdot}2}{0{\cdot}55}$
" ¾ " ..	..	$\frac{0{\cdot}3 \quad 0{\cdot}25}{0{\cdot}55}$
" 1 " ..	..	$\frac{0{\cdot}25 \quad 0{\cdot}25}{0{\cdot}5}$

So that using a two-way tube ¾ NH_3 holds better than ¼.

(3) Experiment using (*a*) 1 p.p.m. NH_3 and 1 Cl_2 through two-way tubes.
(*b*) 1¼ " " " " "
Volume of solutions identical.

	Cart I.	Cart II.
½ hour ..	$\frac{0{\cdot}3 \quad 0{\cdot}3}{0{\cdot}7}$	$\frac{0{\cdot}1 \quad 0{\cdot}1}{0{\cdot}2}$
¾ " ..	$\frac{0{\cdot}3 \quad 0{\cdot}3}{0{\cdot}7}$	
1 " ..	$\frac{0{\cdot}3 \quad 0{\cdot}3}{0{\cdot}7}$	$\frac{0{\cdot}1 \quad 0{\cdot}1}{0{\cdot}2}$
1¼ hours ..	$\frac{0{\cdot}4 \quad 0{\cdot}3}{0{\cdot}7}$	$\frac{0{\cdot}2 \quad 0{\cdot}1}{0{\cdot}3}$
2½ " ..	$\frac{0{\cdot}25 \quad 0.25}{0{\cdot}5}$	Demonstrates superior holding powers of 1 NH_3 and 1 Cl_2 and the loss resulting from use of excess of NH_3.
5 " ..	$\frac{0{\cdot}25 \quad 0{\cdot}2}{0{\cdot}4}$	

(4) Pouring Cl_2 and NH_3 solutions simultaneously through a funnel, using 1 Cl_2 and 1 NH_3; after one hour $= \frac{0{\cdot}3 \quad 0{\cdot}3}{0{\cdot}7}$, so this agrees with two-way tube.

(5) Method of pouring without using apparatus:—

Fill cart above baffle with water, pour in 1 p.p.m. of NH_3, count five, then pour Cl_2 on exactly same spot on surface of water; count ten and stir. Cl_2 solution passes through diffusing NH_3. Faint fresh smell. Taste dry, not chlorinous.

After 1 hour, $\frac{0{\cdot}55 \quad 0{\cdot}3}{0{\cdot}9}$; 2 hours, $\frac{0{\cdot}5 \quad 0{\cdot}3}{0{\cdot}85}$; 2½ hours, $\frac{0{\cdot}4 \quad 0{\cdot}4}{0{\cdot}85}$;

4 hours, $\frac{0{\cdot}7 \quad 0{\cdot}4}{0{\cdot}85}$; 5 hours, $\frac{0{\cdot}4 \quad 0{\cdot}3}{0{\cdot}8}$; after 21 hours, $\frac{0{\cdot}35 \quad 0{\cdot}15}{0{\cdot}5}$

The effect of longer contact of dilute solutions is beneficial and minimizes loss and improves holding power.

Iron content of water throughout these series = 0·15 parts per 100,000.

(6) Comparative test using 1 p.p.m. Cl_2.

10 minutes	=	0·8.	Smell chlorinous.
2 hours	=	0·3 0·1	
		0·4	
3 ,,	=	0·2 0·5	
		0·25	
18 ,,	=	0·5	

Series D.

Trial of Pouring Method.

(1) Three carts—Bourley water in each—250 c.c. broth culture; 250,000 million *B. coli;* 1 p.p.m. Cl_2 in all cases.

	Cart A. 1 p.p.m. NH_3 + 1 Cl_2	Cart B. 0·75 p.p.m. NH_3 + 1 Cl_2	Cart C. Cl_2 only
Average ..	0·4 0·4	0·6 0·4	0·2 0·05
	0·8	0·95	0·3
Plating, ½ hour ..	About 100 cols. ..	About 100 cols. ..	Enormous growth
,, 1 ,, ..	,, 25 ,, ..	,, 4 ,, ..	,, ,,
Titrations, 2 hours	0·4 0·4	0·5 0·5	0·25 0·25
	0·8	0·9	0·45
Plating, 2 ,,	3 cols. ..	2 cols. ..	Thousands of cols.
,, 3 ,,	Negative ..	4 ,, ..	200 cols.
Titrations, 4 ,,	0·4 0·3	0.4 0·4	0·3 0·2
	0·75	0·9	0·5
Plating ..	1 col. ..	Negative ..	Over 100 cols.

Little to choose between 0·75 and 1 p.p.m. Clear demonstration of the superiority of the NH_3 combination over Cl_2.

(2) Trial with Basingstoke Canal water, stationary carts, water pumped through reels but without alum clarification. Major Elliott was present. 250,000 million *B. coli* added.

	Cart A. 1 Cl_2 + 0·75 NH_3		Cart B. 1 Cl_2 only
10 minutes	0·7 0·5	.. ..	0·0 0·1
	1·1		
20 ,, plating	20 cols.	.. ..	Just on 100
40 ,, titrations ..	0·5 0·5	.. ..	0·1 0·05
	1		0 17
Plating	2 cols.	.. ..	19 cols.
60 minutes, titrations ..	0·6 0·4	.. ..	0·1 0·5
	1		0·15
Plating	1 col.	.. ..	41 cols.
1 hour 30 minutes, titrations	0·6 0·35	.. ..	0·05 0·1
	1		0·15
Plating	Negative	.. ..	36 cols.
2 hours, titrations ..	0·55 0·45	.. ..	0·05 0·1
	1		0·15

Irregular action appears to be taking place. We are now using stationary carts. Owing to labour entailed it is not possible to get these at suitable times.

(3) Trial with unclarified Basingstoke Canal water—after heavy rain. Water very thick and full of debris; raw water pumped direct into cart—carts stationary. First titration, 1·8, which is almost double the dose added.

	Cl_2 only — 1 p.p.m.	$0·75\ NH_3 + 1\ Cl_2$
½ hour, plating	Nil	10 cols.
1 " titrations	0·05 0·1 / 0·15	0·5 0·5 / 1
Plating	61 cols.	12 cols.
2 hours, titrations	0·05 0·1 / 0·15	0·45 0·5 / 1
Plating	74 cols.	20 cols.
23 hours, plating	89 "	28 "

Allowing the taps to dribble throughout the experiment. The initial titration of 1·8 p.p.m. and the gradual increase of colonies indicate that imperfect mixing is taking place, and that running off the stronger solution early on is taking place.

(4) Cart experiment, clarified canal water: 500 million *B. coli* added.

	(A) 1 Cl_2 ½ NH_3 p.p.m.	(B) 1 Cl_2 ½ NH_3 p.p.m.	(C) 2 Cl_2 1 NH_3 p.p.m
Plating—20 minutes	96 cols.	103 cols.	38 cols.
Titrations	0·35 0·35 / 0 7	0·3 0·35 / 0·75	0·8 0·6 / 1·5
Plating—40 minutes	25 cols.	30 cols.	Negative
Plating—60 minutes	24 cols.	35 cols.	Negative
Titrations	0·2 0·35 / 0·65	0·3 0·3 / 0·65	0·8 0·7 / 1·4
Plating—90 minutes	2 cols.	7 cols.	Negative
Titrations, 2 hours	0·3 0·3 / 0·6	0·3 0·3 / 0 65	0·8 0·7 / 1·4
Titrations after 24 hours	0·1 0·15 / 0·25	0·15 0·1 / 0·35	0·5 0·1 / 0·75

(B) Holding well using 1 p.p.m.

(C) Is tasteless.

Series E.

Titration Experiments.

(1) Attempts at making a strong solution in bucket by pouring method; adding 0·375 grm. NH_3 followed by 0·5 grm. Cl_2.

Bucket contents should be fifty-five times stronger than cart water. Water against N/10; this should give a 5·5 c.c. titration but only gives

$$\frac{1·95 \quad 0·45}{2·4} = \text{loss of 50 per cent.}$$

(2) Cart experiment—Bourley water.

Effect of allowing streams of Cl_2 and NH_3 solutions to meet. Ammonia 0·75 p.p.m. and Cl_2 1 p.p.m.

$$\text{Titration} = \frac{0{\cdot}15 \quad 0{\cdot}15}{0{\cdot}3} = \text{loss of 70 per cent.}$$

(3) Cart experiment.

Adding Cl_2 first, counting five, then adding NH_3 0·7 p.p.m., counting ten; mix.

$$\text{After } \tfrac{1}{2} \text{ hour, } \frac{0{\cdot}75 \quad 0{\cdot}15}{0{\cdot}9}$$

Note.—Mostly first fraction akin to a chlorine titration, but this is not free because no absorption has taken place.

(4) Repeated, putting NH_3 in first.

$$\text{After } \tfrac{1}{2} \text{ hour, } \frac{0{\cdot}5 \quad 0{\cdot}5}{1{\cdot}0}$$

(5) Repeated cart experiment, Bourley water. Ammonia poured first—dosing NH_3 1·5 p.p.m. and 2 p.p.m. Cl_2.

$$\tfrac{1}{2} \text{ hour, } \frac{1{\cdot}3 \quad 0{\cdot}4}{1{\cdot}7}; \quad 1 \text{ hour, } \frac{1{\cdot}2 \quad 0{\cdot}5}{1{\cdot}75}$$

Practically tasteless; fresh smell; ? faint taste Cl_2; really a dry taste.

(6) Cart experiment—Bourley water.

Added first 2·25 NH_3, counted 20; added 3 p.p.m. Cl_2, counted 20; stirred.

After half-hour contact—smell fresh; slight taste; shade stronger than in Experiment (5) above.

$$\tfrac{1}{2} \text{ hour, } \frac{1{\cdot}8 \quad 0{\cdot}8}{2{\cdot}8}; \quad 1 \text{ hour, } \frac{1{\cdot}8 \quad 0{\cdot}7}{2{\cdot}7}$$

Added to same cart 0·75 NH_3 = total 3 p.p.m.; well stirred; taste fainter.

$$\text{Titrations after 20 minutes, } \frac{1{\cdot}8 \quad 0{\cdot}7}{2{\cdot}7}$$

Added further $\tfrac{1}{2}$ part NH_3 = 3·5 p.p.m. NH_3 added.

$$\text{After 20 minutes, } \frac{1{\cdot}5 \quad 0{\cdot}7}{2{\cdot}7}; \quad \text{after 20 hours, } \frac{1{\cdot}8 \quad 0{\cdot}3}{1{\cdot}9}$$

Faint taste dry saline; smell fresh; further addition of NH_3 does not affect compounds, but tends to reduce taste.

Series F.

After two nights' frost (4 *degrees*) :—

(1) Clarified canal water containing 500 million *B. coli.*

A.	B.
1·5 Cl_2 + 0·75 NH_3	1·5 Cl_2 + 1·1 NH_3
Plating, 20 minutes. Better than B.	Full of growth.
Titrations, $\frac{0{\cdot}9 \quad 0{\cdot}7}{1{\cdot}6}$	$\frac{0{\cdot}9 \quad 0{\cdot}6}{1{\cdot}7}$
40 minutes plating. 8 cols.	70 cols.
60 ,, ,, 4 cols.	15 cols.
Titrations, $\frac{0{\cdot}7 \quad 0{\cdot}7}{1{\cdot}3}$	$\frac{0{\cdot}7 \quad 0{\cdot}7}{1{\cdot}2}$

(2) Crude canal water with 500 milion *B. coli*.

$1{\cdot}5\ NH_3 + 2\ Cl_2$

30 minutes $\dfrac{0{\cdot}9 \quad 0{\cdot}9}{1{\cdot}8}$ Moderate number of colonies.

60 ,, $\dfrac{0{\cdot}9 \quad 0{\cdot}7}{1{\cdot}65}$ 4 cols. only.

(3) Same experiment as (1) of this series, but adding Cl_2 first followed by NH_3.

Plating, 20 minutes ; plate covered with growth
Titrations .. .. $\dfrac{0{\cdot}9 \quad 0{\cdot}3}{1{\cdot}05}$

Plating, 40 minutes ; plates covered with growth
,, 60 ,, 80 cols.
Titrations 40 minutes .. .. .. $\dfrac{1{\cdot}0 \quad 0{\cdot}1}{1{\cdot}1}$

,, 60 ,, ... $\dfrac{1{\cdot}0 \quad 0{\cdot}1}{1{\cdot}1}$

,, 2 hours .. .. .. $\dfrac{1{\cdot}0 \quad 0{\cdot}1}{1{\cdot}0}$

Note.—Titrations all on free side. Killing power nothing like as good as A.

Series G.

(1) Study of the effect of baffles in the water cart upon diffusion of reagents. Bourley water with 500 million *B. coli*. Pouring 0·75 NH_3 followed by 1·1 Cl_2. No mixing.

Titrations after ½ hour $\dfrac{0{\cdot}7 \quad 0{\cdot}7}{1{\cdot}5}$; 1 hour $\dfrac{0{\cdot}7 \quad 0{\cdot}8}{1{\cdot}6}$

Taking samples at top of baffles.

1st compartment, right .. $\dfrac{0{\cdot}3 \quad 0{\cdot}6}{0{\cdot}9}$

2nd ,, left .. $\dfrac{0{\cdot}1 \quad 0{\cdot}15}{0{\cdot}25}$

Bottom of cart 3/4 hour .. $\dfrac{0{\cdot}4 \quad 0{\cdot}7}{1{\cdot}1}$

In the regimental water cart, two baffles at right angles to each other cut the cart into four compartments, which communicate above and below by relatively small openings and restrict diffusion.

With well diffused organisms, the germicidal effect in the different compartments should vary enormously. *Vide* titrations above.

(2) Cart experiment, using bleach in regulation manner.

Horrocks's test, 2nd cup.
Scoops bleach = 2·2/3 p.p.m.
After ½ hour, top of cart, 0·5 p.p.m.
From taps = 3·2 p.p.m.

The irregularity in dosage and germicidal action in previous experiments is explained by the very complete baffling in the regimental water-cart. It is essential with draught animals that surging in the cart should be eliminated, still at the same time if carts are not in movement adequate mixing cannot take place and no amount of agitation with rods or paddles will cause

solutions to diffuse equally from one compartment to the others. Freer intercommunication between the compartments is desirable.

In practice it is essential that carts should be put on the road after dosing in order to facilitate mixing, as it is impossible to eliminate the effect of the baffles in any other way.

The experiments in the preceding series cannot be taken as typical, but for comparative purposes they serve a useful purpose.

More definite and reliable experimental results would be obtained if tanks without baffles were used. It is thought that 11-gallon glass accumulator tanks would meet the case.

Series H.

With Carts in movement :—

(1) Canal water—without alum clarification. 500 million *B. coli* added.

		A.	B.
		NH_3 0·75 + Cl_2 1·5 p.p.m.	NH_3 1 + Cl_2 2 p.p.m.
Plating, ½ hour	..	Negative	Negative
Titrations ..	..	0·4 0·4 / 0·8	0·8 0·7 / 1·5
Plating, 1 hour	..	Negative	Negative
Titrations ..	..	Same as ½ hour	

Remarks.—Note : Immediate improvement, due to adequate mixing.

(2) Clarified water from canal containing *B. coli* in 1/10 c.c. Solutions added when cart is half full.

CARTS :—	A.	B.	C.
	0·5 NH_3 + 1 Cl_2 p.p.m.	0·75 NH_3 + 1·5 Cl_2	1 NH_3 + 1·5 Cl_2
After 20 minutes ..	1 col.	Negative	Negative
„ 40 „ ..	Negative	„	„
„ 60 „ ..	„	„	„
Titrations after 1 hour ..	0·3 0·4 / 0·7	0·4 0·7 / 1·1	0·55 0·6 / 1·1
„ „ 24 hours ..	0·25 0·0 / 0·25	0·3 0·25 / 0·55	0·5 0·1 / 0·6

Remarks.—Good effect continues.

(3) Crude canal water full of mud after heavy rain and boating. 500 million *B. coli* added. Reagents added as usual when carts half full.

	CART A.	CART B.
	0·75 NH_3 + 1·5 Cl_2	1·5 NH_3 + 3 Cl_2
Plating, 20 minutes ..	Negative	Negative
„ 40 „ ..	„	„
„ 60 „ ..	„	„
Titrations after 1 hour..	0·4 0·5 / 0·9	1·3 0·7 / 2 0

Remarks.—A good demonstration of the effect of efficient mixing.

(4) Crude canal water (without clarification)—pea-soup colour—troops bathing and boating— and 500 millions *B. coli* added.

NH_3 0·5 p.p.m. + Cl_2 1 p.p.m.

Plating, 20 minutes	.. 27 cols.	Titrations	..	$\frac{0·35 \quad 0·3}{0·6}$
,, 40 ,,	.. Negative	,,	..	$\frac{0·3 \quad 0·3}{0·6}$
,, 60 ,,	.. ,,	,,	..	$\frac{0·3 \quad 0·3}{0·6}$

Horrocks's test = Third cup with a 33 per cent bleach
Cl_2 gas = Second cup

Desired effect produced by 1 p.p.m. of Cl_2 and ammonia.

Series I.

Complete removal of all organisms not desired—comparative results of pouring technique and allowing contact of reagents outside the cart, using two buckets per water cart.

Unclarified canal water with 250 c.c. of broth culture containing 1,000 millions *B. coli* per c.c. in each cart.

(1) A. Pouring usual way. B. Dosing 0·25 NH_3 and 0·5 Cl_2 in each bucket.

	A.	B.
Plating 20 minutes ..	Enormous growth	Enormous growth
Titrations	$\frac{0·15 \quad 0·25}{0·4}$	$\frac{0·0 \quad 0·5}{0·5}$
Plating 60 minutes ..	Enormous growth	A few hundreds
Titrations	$\frac{0·15 \quad 0·20}{0·35}$	$\frac{0·0 \quad 0·4}{0·4}$

Bucket dosing seems the better—Cl_2 found to be 20 per cent under strength.

(2) Repeated above.

	A. Pouring usual way	B. Buckets
Plating ½ hour ..	6 cols.	Some hundreds
,, 1 ,, ..	Negative	Negative
Titrations	$\frac{0·2 \quad 0·1}{0·3}$	$\frac{0·2 \quad 0·25}{0·45}$

In light of previous experiment, advantage seems to lie in separate dosing. This was afterwards confirmed.

(*To be continued.*)

TROPICAL TYPHUS IN A TRAINING CAMP.

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An investigation of the continued fevers of the Federated Malay States has shown that typhus occurs in a sporadic form from one end of the country to the other. It differs essentially from the ordinary type by reason of its lack of infectivity. It does not pass direct from one person to another and there is no evidence that it is carried by lice.

Megaw (1921) has drawn attention to a sporadic and localized form of typhus in the Kumaon district of the Himalayas, which he considers is probably carried by ticks. Yersin and Vassal saw non-infectious cases in Indo-China during 1908. Smith investigated a similar outbreak in the sugar-cane fields of Queensland in 1910. In 1922, Maxy and Havers saw thirteen cases of the same kind of fever, with a positive Weil-Felix reaction, in Alabama. There was no evidence of louse infestation in these cases. In 1923, Hone reported the occurrence of a typhus-like disease in and around Adelaide. The Weil-Felix reaction was positive and the disease resembled typhus in every way except that it did not spread from man to man and there was no evidence that it was carried by lice. In February, 1925, Megaw, Shettle and Roy described an outbreak of typhus-like fever among a body of 2,000 soldiers in Central India. The men, who were engaged in manœuvres, were living in two camps situated in a country covered with jungle and uncultivated scrub. Though the condition of the camp was favourable to direct infection from person to person there was no evidence that it occurred, and when a man fell sick he did not infect his fellows who shared the same tent. Lice were excluded as vectors, and Megaw, who incriminates ticks, suggests that it should be called "tick-typhus." It attacks persons leading an open-air life, camping or marching in the jungle or scrub, and in this respect it resembles the tsutsugamushi of Japan and the spotted fever of the Rocky Mountains. The Weil-Felix reaction was negative in Megaw's cases, but possibly the *Bacillus proteus* culture was at fault; no mention of positive control tests is made in his report.

The typhus of the Malay States resembles these sporadic forms very closely and we call it "tropical typhus" because it appears to be more common in the tropics than the epidemic form; we do not mean to imply that it occurs nowhere else. It is necessary to distinguish it by some name; to call it simply "typhus" is to mislead and alarm the public who, though they may be quite ignorant of everything else about typhus, know that it is highly infectious and may spread like wild-fire.

Kuala Lumpur, the capital of Federated Malay States, is only four

degrees north of the Equator; the mean temperature is about 84° F. and there is no appreciable seasonal variation. Typhus had not been recognized in the country before August, 1924. In the following eight months, twentv-six cases were diagnosed in different parts of the peninsula; in most cases by the examination of a blood specimen which had been sent to the laboratory because the patient had typhoid symptoms.

In the autumn of 1924 a military training camp was formed just outside the mining village of Sungei Besi, nine miles from Kuala Lumpur. It was occupied by some six hundred men belonging to a British regiment which was stationed in Singapore. An advance party came up on September 10, but the main body did not arrive until a fortnight later. Five cases of typhus occurred between the ninth and the sixteenth of October and a sixth case on November 7, a week after the regiment had returned to Singapore. There was no evidence that the disease had been introduced into Sungei Besi by the soldiers. No cases had occurred in Singapore where they came from, but there had been at least four cases in the Malay States, shortly before their arrival. We examined the blood of twenty-three healthy men in the regiment, as controls, including those who had served in the Near East during the war, but none of them gave a positive Weil-Felix reaction. There was no question of the men having become infected on the journey from Singapore, because they had travelled, not only by different trains, but on different days. Several of them had never left the camp from the time of their arrival to the day on which they were taken ill, and one must conclude that they became infected within its precincts.

The general features of the disease were similar to those of typhus in other parts of the world. Only two of the men were seriously ill, the others had very mild attacks and all of them recovered. Before the true nature of the disease was disclosed by the Weil-Felix reaction, two of the patients had been notified to the Health Department as cases of typhoid fever, two had been treated for malaria, one had been diagnosed as influenza and one as bronchitis.

The incubation was as short as twelve days in one instance; Corporal H., the fifth case, arrived in the camp on October 1, and was taken ill on the twelfth.

The onset was sudden, with headache, chills, pains in the limbs and injection of the conjunctivæ, like influenza. The disease developed rapidly, and by the end of the first week the two severe cases were in a busy, muttering delirium, like men in the third week of an attack of typhoid fever. Only one of them had a really profuse rash; in the remainder, it was either evanescent or inconspicuous. Other symptoms were a general enlargement of the lymphatic glands in two, splenic enlargement in one, loss of knee-jerks in two, deafness in one and bronchitis in three. The respirations were increased to over thirty in three patients, and one was much troubled by meteorism. The temperature was remittent; it reached

its height on the eighth or ninth day and came down to normal, by rapid lysis, between the twelfth and fifteenth days, except in one instance where it was prolonged by broncho-pneumonia.

The Weil-Felix action was positive in all and was highest during convalescence, towards the end of the third week. In three cases, the maximum titre was between 1,000 and 3,000; in the other three, it was more than 7,000. We employed, for this test, an emulsion of living organisms (given to us by Dr. A. N. Kingsbury) which had been obtained from the Lister Institute in 1921. A dilution of 1 in 200 was taken as the limit above which the reaction was regarded as positive. Repeated tests were made in each case and the evidence of a waxing and waning titre, obtained in this way, was cogent proof of active disease.

Control tests were made with the blood of 365 people; some of these were healthy but the majority were hospital patients, with various ailments, whose blood was sent to the laboratory for Widal's reaction. Eighteen cases of typhoid fever were included and all gave negative Weil-Felix reactions. *B. proteus* X 19 was not agglutinated at a titre above 1 in 30, in 359 cases; it was agglutinated at 1 in 60, in 4; and at 1 in 120, in 2. There was some evidence that the last two cases had suffered from typhus.

Marris's atropine test for typhoid fever was applied in two cases; in one, on the fifteenth day of illness, and in the other, on the eighth day. The result was negative in both; but in the latter the escape was only fifteen beats. Widal tests and examination of the excreta for organisms of the enteric group were negative, except for the presence of agglutinins, in the blood, due to prophylactic inoculations.

We did not have the opportunity of inoculating animals with blood collected during the first week of illness, when the virus of typhus is plentiful. A guinea-pig was inoculated with blood drawn from one of the patients on the eleventh day, but the injection was not followed by any febrile reaction.

The epidemiology of typhus in Malaya differs, and differs very widely, from the epidemiology of epidemic typhus as it occurs in Eastern Europe. In the camp at Sungei Besi, infection did not pass from the sick to the healthy. The men slept close together, four in a tent, but no two cases came from the same tent, or even from tents which were next to each other, and none of the medical officers, nurses or orderlies, became infected.

The camp was situated on one side of a valley about 160 feet above sea-level, with slightly rising ground behind it and hills in front. The site was dry and covered with coarse grass known locally as *lalang* (*Imperata cylindrica*). It is the principal grazing ground for the cattle of the neighbourhood. Close by the entrance to the camp, from the village road, there were several cattle-sheds and thatched huts occupied by Punjabi bullock-cart drivers. We collected the blood of these men for examination by the Weil-Felix reaction. One of them, who looked very thin and pale, was staying in his house because he was not strong enough to go out with the

cattle. His blood agglutinated *B. proteus* X 19 in a dilution of 1 in 120, and the examination was repeated on two subsequent occasions with the same result. The man's neighbours told us that he had been ill, though he himself denied it, through fear of being removed to hospital, and it is probable that he had recently recovered from an attack of typhus.

Three days after the camp was removed a Tamil cowherd fell ill with typhus. He lived more than a mile from the site of the camp, but he pastured his own cows in its neighbourhood every day. A few weeks later two Punjabi carters contracted typhus in the same village. They also were accustomed to let their cattle graze about the site of the camp, and they themselves had been employed there with their carts.

A consideration of all these facts shows that they incriminate the waste lalang-covered land where the camp was situated, and the source of the virus which infected the Sungei Besi cases, and the history of patients from other parts of the country corroborates this opinion, for there was the same connexion between waste land and infection in most of them. In this respect the disease resembles the mite-borne tsutsugamushi, especially the Sumatran variety described by Schüffner, and the tick-borne spotted fever of the Rocky Mountains, both of which are associated with uncultivated land. The same peculiarity was noted by Smithson (1910) in the typhus-like fever of the Mossman district of North Queensland and by Megaw in the typhus of the Himalayas.

The ætiology of the disease is obscure, for we are ignorant of the medium through which infection takes place. No lice were found on any of the patients, and it is hard to believe that six men in a camp could be infected with typhus by lice, without passing on the disease to their comrades in a single instance.

Megaw has brought forward evidence which incriminates ticks as carriers of the virus in Himalayan typhus, and possibly the ætiology of the disease in the Malay States can be explained in the same way. The close association of most of the Asiatic patients with cattle, and the fact that the European soldiers had been camping in a place which is used as a grazing ground, are arguments in favour of ticks as vectors of the disease. In places where there are cattle there are usually rats, the site of the military camp is notorious for its rats. Rodents act as reservoirs of the virus in the spotted-fever of the Rocky Mountains; they harbour the larval ticks, while the adult forms are conveyed from one place to another by large animals, such as cattle.

The Malayan disease resembles, in many ways, a typhus-like fever which occurs in Deli, Sumatra, and which is considered by Schüffner (1915), who first described it, to be a variety of tsutsugamushi. According to Schüffner its course can best be described by saying that it corresponds in all respects with that seen in enteric fever. This course, he says, sharply distinguishes it from typhus with its brusque onset and its termination by crisis. There is usually a small ulcer in the groin or axilla, associated with enlargement

of the neighbouring lymphatic glands, and similar to the initial ulcer of tsutsugamushi. This ulcer marks the point of infection and is produced by the bite of a small mite, which is a parasite of the field rat. The ulcer is discernible in all European cases, but it can easily be overlooked in native labourers among the multitude of lesions which are common on their dark skins. The habitat of the mite, *Trombicula deliensis*, which carries the disease, is uncultivated land. Walch saw over a hundred cases, during 1923, among coolies who had been clearing undergrowth from some abandoned land on a rubber estate in Sumatra. The propinquity of Sumatra to the Malay Peninsula makes it probable that a disease which is common in one country occurs in the other as well, and the question arises: Is the typhus of the Malay States the same as the form of tsutsugamushi which Schüffner described in Sumatra? The correct answer is probably in the negative: firstly, because the primary ulcer and the localized glandular enlargement which are characteristic of the disease described by Schüffner do not occur in the Malayan cases; and secondly, because the Weil-Felix reaction is always positive in the latter. But, apart from tsutsugamushi, tropical typhus probably does occur in Sumatra, and Dr. Vervoort, Director of the Pathological Laboratory at Deli, has recently sent us particulars of some cases of continued fever, without a primary ulcer, which gave a positive Weil-Felix reaction and resembled the Malayan fever very closely if they were not identical with it.

We believe that the disease has a wide distribution in both hemispheres. The most recent report of its occurrence is from the Rio Grande valley of Mexico. Typhus in a severe form, known locally as tarbadillo, has been endemic in the Mexican plateau, at an elevation of some two thousand feet, for hundreds of years, but it was not recognized in the lowlands until last year, when Sinclair and Maxy (1925) investigated a small outbreak of mild typhus in an American cavalry camp on the frontier. Inquiries made among the medical practitioners of the neighbourhood showed that the disease had existed for years in the Rio Grande valley, and some of the doctors had seen hundreds of cases, about two per cent of which were fatal.

The fever was characterized by an abrupt onset, with headache, rigors and vomiting. The temperature reached its highest point during the first week, it became remittent in the second week, and it returned to normal by about the fourteenth day, usually by lysis, but sometimes by crisis. The shortest time in which the fever ran its course was seven days, and the longest was twenty-five days. A typhus-like eruption appeared about the fifth day.

Sinclair and Maxy investigated twenty cases; only three of them were seriously ill and none died. Three of them were slightly delirious, the majority were dull and apathetic. A slight cough was present in all cases. Leucocyte counts were normal. The Weil-Felix reaction was positive. A few guinea-pigs were inoculated, but they failed to show the character-

istic febrile reaction, and they were not immunized against the virus of epidemic typhus.

No two cases occurred in any one house and there was no evidence of direct infection from man to man. No body-lice were found and the authors are inclined to blame head-lice as the vectors, but the American soldiers who contracted the disease harboured none and inquiry showed that many cases had occurred among the better-class inhabitants of the valley who were free from vermin of every kind.

Sinclair and Maxy consider that the typhus of the Rio Grande is the same as the mild form described by Brill, which is endemic in New York under the name of Brill's disease, and which has been proved to be true typhus by the test of immunity.

The descriptions of these outbreaks in different quarters of the globe are so much alike, and resemble so closely the disease which we call tropical typhus in Malaya, that we believe them to be records of the same disease. We fully expect that the application of the Weil-Felix reaction, with an active standard strain of *B. proteus*, will show that this view is correct, and thus one more disease will be removed from the dwindling group known as the unclassified fevers.

Records of Cases.

Case No. 1, *Pte. L.*—This was a severe case. The temperature rose to 105° F. on the eighth day, the patient lay in a muttering delirium for about ten days and the fever was prolonged by broncho-pneumonia. The man, aged 23, was a private soldier. He came from Singapore to the military camp at Sungei Besi, nine miles from Kuala Lumpur, on September 23, 1924. He was taken ill suddenly with shivering and headache on October 9, sixteen days after his arrival at the camp, and was admitted to hospital, in Kuala Lumpur, on the fifth day of illness. A macular eruption, like a syphilitic roseola, was noticed, on the ninth day, over his shoulders and back, but it had disappeared entirely six days later.

His temperature was remittent, being three or four degrees higher in the evening than in the morning. After the fourteenth day it came down to normal, or nearly normal, every morning, but it went up again at night and did not become consistently normal until the twenty-fifth day. The broncho-pneumonia, from which this patient suffered, was probably the cause of the protracted fever.

When we first saw him, on the fifteenth day of his illness, his face had a curious, congested, leaden hue; his conjunctivæ were red and his lips were covered with sordes. He was lying in a typhoid state, plucking at the bedclothes and continually muttering in a low, tremulous voice. He appeared to be quite unconscious, but, like a man in alcoholic delirium tremens, he could pull himself together and answer questions. At night his delirium was more active, and many times he tried to get out of his bed. He remained in this state until the twenty-first day and, at one time, the

prognosis was so grave that a message was cabled to his friends in England; but he recovered, as we have seen others in a worse case recover from this disease, when there appeared to be little or no hope that they could live.

There was no enlargement of the spleen or lymphatic glands. On the fifteenth day the knee-jerks were present and the hearing was unimpaired, but, four days later, the reflexes were unobtainable and he was noticeably deaf. No lice were found on the patient. Marris's atropine test was negative on the fifteenth day.

Fæces and Urine: Specimens were examined bacteriologically on four occasions, with negative results.

Urine: The diazo-reaction was positive.

Widal reaction: The patient had received prophylactic inoculations in January, 1922, and his blood agglutinated both *B. typhosus* and *B. paratyphosus* B, at a titre of 1 in 120, on the tenth, the thirteenth and the fifteenth days.

The Weil-Felix reaction was :—

On the 15th day	1 in 3,000
,, 23rd ,, ...	1 in 7,680
,, 29th ,, ...	1 in 1,920
,, 37th ,, ...	1 in 480
,, 42nd ,, ...	1 in 480

(Under the care of Dr. J. G. Castellain.)

Case No. 2, *Pte. B.*—This was a mild case in which the temperature did not rise above 101·6° F. The patient was a cook, aged 24, belonging to the Headquarter company of his regiment. He came to the camp at Sungei Besi on September 23, and, according to his own statement, he did not leave it until he was taken to hospital.

His illness began suddenly on October 16, twenty-three days after his arrival, with shivering, headache and pains in the limbs. There was no cough or running of the eyes, nor was there sneezing, epistaxis or vomiting at the onset. He was admitted to hospital on the fourth day of his illness, with a temperature of 100·8° F., which became normal on the twelfth day and did not rise again.

We saw him for the first time on the seventh day of his illness. There were some petechial spots in his axillæ and the cervical and axillary glands were enlarged. On the ninth day, his hands, face and tongue were very tremulous, but this passed off in a few days. There was a copious branny desquamation over the chest and abdomen on the fifteenth day.

Urine: The diazo-reaction was negative on the ninth day.

The Weil-Felix reaction was :—

On the 7th day	1 in 900
,, 15th ,, ...	1 in 3,800
,, 20th ,, ...	1 in 7,680

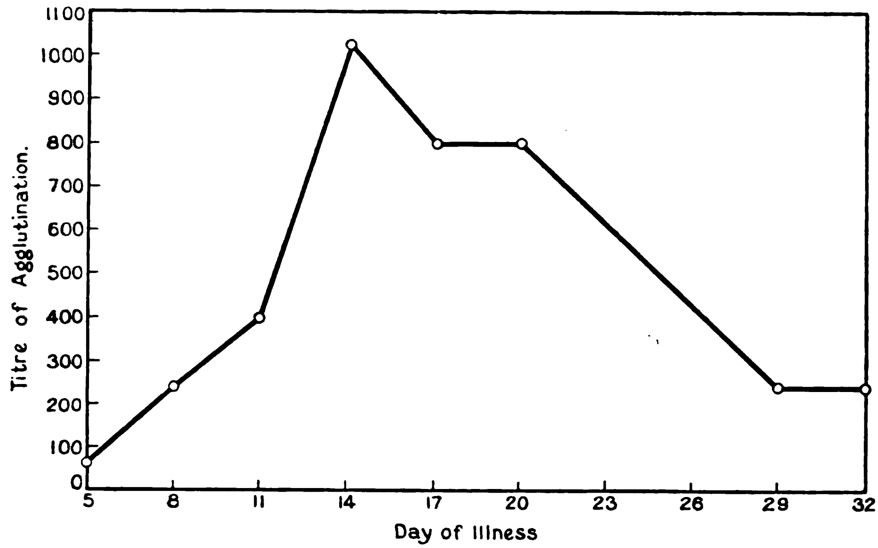
(Under the care of Dr. J. G. Castellain.)

Case No. 3, *Pte. J.*—This man was a private, aged 22, in C company of the same regiment as the last two patients. He arrived in the Sungei Besi

camp on September 23, and was taken ill on October 16, the same day as the last case, twenty-four days after his arrival. He reported sick, with a blotchy rash on his face (which soon disappeared), pains in the knees and drowsiness. He was admitted to hospital, in Kuala Lumpur, on October 20, the fourth day of his illness.

On the seventh day, when we first saw him, his body was thickly covered with a well-marked macular rash of raised, dusky blotches, which were about one centimetre in diameter and fairly close-set, but not confluent. The eruption was general except for the face. There was not very much on the extensor surface of the arms, but it was profuse on the inner aspects. The macules were present on the palms and soles, and

Agglutination curve of the blood of Private J., Case No. 3, with *B. proteus* X 19.



there was redness of the fauces. They were thick all over the trunk, and thicker on the chest than on the abdomen. The colour and general appearance of the rash bore a striking resemblance to the macular eruption of secondary syphilis. The rash had faded considerably by the tenth day, but some of the spots had become purpuric, especially those on the thighs. The remains of the rash were still visible as dusky mottling on the abdomen as late as the thirty-third day.

The patient had a remittent temperature, which came down to normal by quick lysis on the thirteenth day. It was never as high as 103° F., and the pulse was never more than 100. The respirations were quickened to thirty-six on the ninth day. Increased frequency of respiration was a noticeable feature in the majority of cases, even in those which had no bronchitis. The spleen was not palpable, but there was a general glandular enlargement. There was no epistaxis and no

vomiting. The eyes were injected. There was no deafness. The knee-jerks were present on the seventh day, but they had disappeared by the tenth.

Nervous symptoms were prominent. On the seventh day the patient was twitching and tremulous; muttering to himself continually, like a patient in the third week of typhoid fever. By the ninth day he was in a busy delirium, but he could control his attention and answer questions intelligently in a most surprising manner. On the tenth day the temperature dropped suddenly from 102·2° F. down to 99° F.; the delirium left him and there was great change for the better.

A diagnosis of malaria was made at the beginning of this patient's illness, and he was given quinine. No parasites were found in his blood. There was no history of syphilis. He stated that he had not left the camp while he was at Sungei Besi. No lice or scratch-marks were found on him. Marris's atropine test was negative on the eighth day, but the escape was only fifteen. The diazo-reaction was negative on the sixth and ninth days.

Urine and fæces: No pathogenic organisms were isolated from specimens collected on the sixth and ninth days.

Widal reaction: The patient had received prophylactic inoculations. His blood agglutinated *B. typhosus* at 1 in 30 on three occasions. It did not agglutinate *B. paratyphosus* A, B, C, or *Brucella melitensis.*

Animal inoculations: A guinea-pig was inoculated with the patient's blood on the eleventh day, with negative results.

Weil-Felix reaction was:—

On the 5th day	1 in 60
,, 7th ,,	1 in 240
,, 11th ,,	1 in 400
,, 14th ,,	1 in 1,020
,, 20th ,,	1 in 800
,, 28th ,,	1 in 240
,, 33rd ,,	1 in 240

(Under the care of Dr. J. G. Castellain.)

Case No. 4, *Private C.*—This man, aged 25, was a private in a company of the same regiment. He came with an advance party to the camp at Sungei Besi on September 10, and was taken ill suddenly on October 14 thirty-four days later, with a rigor, severe headache and a cough. He was admitted to hospital in Kuala Lumpur on the fifth day of his illness with the diagnosis of bronchitis. His temperature was remittent and swung between 100° F. in the morning and 103° F. at night. It came down by quick lysis and was normal on the thirteenth day.

We saw this man for the first time on the tenth day of his illness. There was no rash, except some sores on the face, body and thighs, which resembled abrasions or tropical pemphigus. They were covered with hæmorrhagic crusts and had bled a little on to the bed clothes. He still

had a cough, but there were no other signs or symptoms. No lice were found on his person.

Blood: The polynuclears formed seventy-eight per cent, and the eosinophils 1·5 per cent of the white cells on the tenth day.

Urine: The diazo-reaction was negative on the tenth day.

Widal reaction: The patient had received prophylactic inoculations, and his blood agglutinated *Bacillus typhosus* in a dilution of 1 in 60. It did not agglutinate *B. paratyphosus* A, B, C. Nor did it agglutinate *Brucella melitensis.*

Weil-Felix reaction was:—

On the 10th day	1 in 3,000
„ 18th „	1 in 7,680
„ 24th „	1 in 7,680

(Under the care of Dr. J. G. Castellain.)

Case No. 5, *Corporal H.*—This man went into camp at Sungei Besi on October 1, and was taken ill with headache and pains in the limbs on October 12. His temperature from that date, until October 24, ranged between 100° F. and 102·5° F. It came down by lysis and was normal on the fifteenth day. Corporal H's attack was the mildest we have seen, and it was peculiar because there was no cough or lachrymation. It began with "awful pains in the eyes and in the head." There was neither vomiting nor epistaxis.

We first saw the patient on the fourteenth day of his illness. His spleen was palpable and there were some brown macules on the abdomen, which were most numerous around the umbilicus. There were no enlarged glands and no lice were found.

Urine: The diazo-reaction was negative on the fourteenth day.

Weil-Felix reaction was:—

On the 14th day	1 in 480
„ 20th „	1 in 3,840
„ 27th „	1 in 1,920

(Under the care of Dr. J. G. Castellain.)

Case No. 6, *Lance-Corporal P.*—This patient was a lance-corporal, aged 23, in a company of the same regiment. He returned to Singapore, from the camp at Sungei Besi, on October 30, and remained in good health until seven days later, when he was admitted to hospital with fever, headache and an indefinite rash over the abdomen, like prickly heat. The prominent symptoms were meteorism and rapid breathing. The patient's temperature was 104° F. on the eighth and ninth days, and declined by lysis on the thirteenth, fourteenth and fifteenth days. It did not rise above normal after the sixteenth day. His pulse, which was 120 at the height of the fever, was not above 70 after the fifteenth day. The respirations were fifty to the minute on the evening of the twelfth day. We did not see this

patient ourselves and we are indebted to Major D. F. Mackenzie for the notes of the case.

Blood: Leucocytes, 7,000 per cubic millimetre.

Urine and fæces: No organisms of the enteric group were isolated.

Weil-Felix reaction was:—

On the 8th day	Negative
,, 18th ,, ...	1 in 1,250

(Under the care of Major D. F. Mackenzie, D.S.O., R.A.M.C.)

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THE MEDICO-LEGAL ASPECTS OF SELF-INFLICTED WOUNDS ON ACTIVE SERVICE.[1]

By Colonel J. S. WARRACK, A.M.S., T.D., M.D., M.A., D.P.H., Barrister-at-Law.

In this paper dealing with this subject, I propose to confine myself to wounds self-inflicted under active service conditions, where the inflicter survives, and not to take up the differential diagnosis between homicidal and suicidal injuries, which may be studied in any textbook of "Forensic Medicine." Now the self-inflicted wound may be simply defined as one which has been inflicted by an individual on himself. It excites an attitude of suspicion at once, by its situation, and by the manner and circumstances of the infliction.

The self-infliction may be, first of his own volition, with the motive and intention of substituting a lesser danger for a greater, and so removing himself from a position of great personal risk, to one of comparative security, or for some other reason equally cogent to his mind; second, by negligence, handling familiar or unfamiliar weapons or ammunition in a careless way, regardless of the consequences to himself or his comrades, or by forgetfulness of the dangerous nature of the objects of his investigation; third, by accident which means the occurrence of the event independently of the will of the individual and excludes the above.

Therefore, in dealing with cases of self-inflicted wounds these must be distinguished otherwise injustice will be done to the individual, or the State will be prejudiced, or the *moral* of his service be impaired, should the inflicter escape the penalty of his action.

Now the branch of the Service which is most concerned in seeing that the whole matter be put in the proper light to those in authority is the medical branch. The medical officer is bound to be called in sooner or later to express an opinion as to the means by which the wound was sustained, either by the nature of the wound itself, or by inference from the observations of eye-witnesses, or of the circumstances of the occurrence. It is, therefore, essential that he should see as early as possible the wound, the weapon with which inflicted, the place where it was inflicted, and if this is impossible, and in any event, should the exigencies of the Service permit, he should interview the eye-witnesses or read their statements of what occurred. His description of the wound must be accurate, and he should have knowledge of the action of the weapon and of the effect of the missile. His report will be of the greatest possible value in deciding the question of disciplinary proceedings. There are certain principles which

[1] Paper read before the Naval, Military and Air Force Group of the Society of Medical Officers of Health, January 30, 1925.

he must have in mind, and he must bring his diagnostic acumen to bear on the case.

The wound deliberately self-inflicted will be on an extremity, the arm, the leg, the hand, the foot. It may be blackened, but if the shot was fired through a sand-bag, or other obstacle, blackening may be absent; or it may have been inflicted in various ways, ingenious or otherwise, or by the agency of a comrade, but it will not be of a character designedly dangerous to life, unless the motive was suicidal. The negligently, or accidentally self-inflicted wound may be anywhere on the body, and to form the correct opinion other evidence may be necessary, such being that of the eye-witness or evidence of motive. It may be very difficult on active service to secure the eye-witness, and if secured to get him to speak the truth. Wounds may, of course, be self-inflicted by cutting as well as by bullets. Having these things in mind the medical officer will write a concise description in his field report book, giving name, number, unit, place, date, sign the report, have a carbon copy. He must not trust to the field medical card as the only record, as this document is very easily lost; indeed, its loss would be most suspicious, and moreover, it might be altered or varied. The original notes taken by him at the time will be valuable evidence when produced by him later at an inquiry or trial, and could be used as evidence, if he became a casualty, should the Court hold them to be admissible.

The following quotation from the "Manual of Military Law," p. 70, para. 56, 1914 edition, states the law concisely:—

"A statement, written or oral, or an entry which it is a duty of a person to make in the ordinary course of his business, or professional employment, is admissible as evidence after his death, provided it is made contemporaneously with the act to which it relates. But it is only admissible to prove these facts which it was the duty of the person making the statement or entry to include in it, and of which he had personal knowledge."

The best witness then should be the medical officer who saw the casualty first, and he should be in a strong position to help the course of justice.

In getting out a report, he should see the original weapon, or one of similar pattern, and the same principle applies to the missile. He may be required to do some experiments with the weapon, or quote from recognized authorities and produce the books on the point. Should he be able to visit the locality he should reconstruct the positions of all concerned as far as possible, and if practicable, get the eye-witnesses to show him what happened.

Having then obtained all the data possible he should make a clear and concise statement of the facts that have come to his knowledge, and give an accurate opinion based on them, drawing the proper inferences and avoiding qualifications.

If then, the accused is to be tried, the evidence of the medical officer will be ready, there will be no delay. His statement with those of the

other witnesses will be sent to the defence, and the Court will not allow new matter to be brought in for the prosecution at the trial without previous notice to the defence. The defence are not obliged to disclose their case. The accused is presumed to be innocent until proved guilty, and it is for the prosecution to bring his guilt home to him. The medical officer must remember that he will be liable to cross-examination by defending counsel or prisoner's friend, and that the defence will endeavour to prove accident, or failing that, negligence. Therefore what he says in examination-in-chief he should stick to, but if he has anything which may be in favour of the accused, he should say so. He should not volunteer statements but confine himself to answering relevant questions, using plain language, giving as candid and clear answers to the defence as to the prosecution, and avoid any semblance of partiality or bias. He will be entitled to refer to his notes to refresh his memory, but if he does produce in the witness box anything in writing, or print, either side may require him to hand it to the Court for inspection and subsequent questioning.

Under the Army Act, prosecutions as regards officers are taken under Section 16, which reads, "Every officer who, being subject to Military Law, commits the following offence, that is to say, behaves in a scandalous manner, unbecoming the character of an officer and a gentleman, shall, on conviction by court martial, be cashiered."

Prosecutions of soldiers for disgraceful conduct are taken under Section 18, and for self-inflicted wounds Sub-Section 2. The offence must be wilful, and wilfulness must be proved by evidence. Prosecutions for negligence are taken under Section 40: "Every person subject to military law who commits any of the following offences, that is to say, is guilty of any act, conduct, disorder or neglect, to the prejudice of good order and military discipline, shall on conviction by courtmartial be liable . . ." (here follow the penalties).

I will now give an illustrative case in which I was concerned as Counsel, where a misdescription of the wound and an erroneous deduction therefrom were of material assistance to me in upsetting the evidence for the prosecution and so securing an acquittal. This is the story, and I will call the accused H., the first medical officer R., the second medical officer C. and the locality F. The event occurred at the beginning of October, 1916, and the facts were as follows:—

H., a captain in the Royal Flying Corps, S.R., had enlisted as a private, and had served in South Africa in the De Wet rebellion, and then in German South-West Africa. His character was good. He had suffered from sunstroke and was liable to headaches. He came to England in September, 1915, was commissioned as an aviator, obtained his aviation certificate, did a good deal of flying in England, including night-flying over London, until September, 1916, when he was ordered to France. He arrived at a place called F., where he commenced further instruction in flying, he used a Sopwith plane and learned the use of a Vickers gun on

the ground. He did several practice flights both as pilot and as observer. On October 1, 1919, the following events occurred :—

At 11 a.m. he obtained a Colt automatic pistol, had it loaded, put it in the pocket of a plane and left it there. It was found impossible to use that plane, so it was arranged that he should go up in a Sopwith plane. At 2 p.m. he produced the same pistol to a witness, inquired if it was loaded, received some instruction in its working, which he said he did not know. He then proceeded to get into the plane, he had the weapon in his hand, but I elicited that he put it in the left-hand pocket of his leather coat, and accused in evidence said that it was his practice so to do, and other witnesses said that this was not unusual. At 2.20 p.m. he left the ground without a passenger. As regards the Vickers gun, which at that time was the defensive and offensive armament of certain planes, he had asked not to have this loaded, and it was unloaded for him. At, or about, 2.25 p.m., some men playing football in a field about four miles away, saw a plane come down in a swaying manner. It reached the ground, and in a few minutes' time, attracted by curiosity, they went to have a look. The plane had got on fire, and this they put out. Then they saw an airman standing on the left side of the machine, he was wounded in the left arm and blood was running down the sleeve of his leather coat profusely. He was dazed, made some disjointed statements, so they laid him on the stubble, an R.A.M.C. man, one of the players, gave him some brandy, put on a first field dressing and sent for the medical officer.

The first medical officer, R., came on the scene at 3 p.m., saw and redressed the wound in the left arm, and asked a few questions as to what had happened. Accused replied that he had gone up to see the line and the country, he had seen a hostile air craft, tried to fire at it, but his gun was slow in starting, and just then something happened, and he could remember no more about it. Some other general remarks passed, and R. reported that accused was quite rational. Then, in his statement, R. found on examination "that the accused was suffering from a compound fracture of the left forearm, which appeared to have been caused by a bullet entering on the inner side of the arm, and passing out on the outer side, he had not lost much blood, but that the shock and loss of blood might explain the temporary aberration of memory, that the accused had looked round the machine and appeared satisfied." Then R. went on to state "that there was nothing in the wound to cause a suspicion that it had been self-inflicted, but that it was obvious that it had passed from the inside to the outside." He did not see the accused subsequently. All this was sent to the defence.

At 4 p.m. the plane was examined by a party from the unit, and certain discoveries were made. At 9 p.m., some officers of the formation arrived, the witness R. was with them, and they all came to the conclusion that the shot must have been fired inside the fusilage. There was found a hole in the fabric on the left side of the pilot's seat, the pistol was found fully

cocked under this seat. There was a round in the chamber of the pistol, and five rounds in the magazine, which left one round unaccounted for. The shell was not found. The leather coat had two holes in the left sleeve. The Vickers gun was unloaded, and had not been used.

Therefore H., the strange officer who had only been with the unit a short time, had told an untrue story.

To go back to R., he sent a note later to his colleague C., in which he said that he was of opinion "that this officer's injury was probably self-inflicted."

A Court of Inquiry was held, at which H. was not present, but he was questioned at his bedside, and could say nothing to explain what had happened, he could not recall what had happened in the few minutes he was aloft. He was then arrested for trial by court martial, and was charged under Section 16, with "scandalous conduct, etc.," and under Section 40, "negligence," so that if he was not caught under the first he might be brought down by the second. He was sent to my unit to await his trial, and I was asked to defend him.

Now, what had to be got over was this statement about trying to fire at hostile air craft, and other remarks, and it is possible that the effects of the brandy and shock, together, might account for it. It was quite clear that the wound was self-inflicted and in the plane; therefore it must be accounted for by accident which accused could not help. The evidence of the combatant witnesses was quite straightforward, as to the condition of the plane, the weapon, and the unloaded and unfired Vickers gun, but in cross-examination, all the mechanics and armourers were anxious to say, and did say, that Colt automatic pistols were dangerous weapons, and went off very easily. One witness saw H. put the pistol in his left-hand pocket as he got into the plane, and another loaded the pistol in court, and a cartridge went straight into the chamber, the safety catch went to "danger" with a touch, the members of the court became most uncomfortable, and a good effect was produced for the defence by the demonstration of this exhibit.

Previous to the trial, I took an afternoon off to look at a Sopwith plane, and tried to reconstruct the accident. I searched round for a Colt pistol, and this was produced by the dentist, and also a leather coat. So we went to the aerodrome together, and I put him in a Sopwith plane with his left hand on the joy-stick, got him to take the pistol out of the left hand coat pocket, and on withdrawing it, the muzzle pointed straight at the left forearm.

Now, as to the actual condition of the injury, the scars were there, and so the statement of R. could be checked. This was the actual condition: "There were two scars, one on the anterior surface of the forearm, midway between elbow and wrist, towards the radial side, and one on the posterior surface over the ulnar side. The first was circular and healed, the second larger and not quite healed. It was slightly further down from

the elbow." The inference was, that the entrance was in front, and the exit behind, the arm partly pronated, with the elbow flexed. It was put to the medical witnesses, and to the court, that this was consistent with the accidental discharge of the weapon, on the assumption that it had been taken out of the left-hand pocket of the leather coat low down when the accused was sitting in his seat, by means of the right hand, the left being on the joy-stick, and that this accounted for the injury. Moreover, R.'s description meant that the arm must have been in a most unusual position for a man guiding a plane. R. was then shown the scars, and asked to explain his statement that the wound was from inside to outside. He could only say that he was using popular language. Asked also to explain why he said .that it was probably self-inflicted, when he had not made a careful examination, and why he had changed his mind he had no answer. The theory of accident was then put to him, and he was forced to admit the possibility. His colleague, C., at the hospital, was a better witness. He described the injury accurately, said that it was consistent with accident, and with the use of the weapon as above mentioned.

The accused gave evidence. He had a good military record, and testimony from two of his commanding officers, one of whom was in court, and also some evidence from two of the men who were playing football when the plane came down. He was able to say what had occurred previous to the flight only, and his cross-examination was directed to suggest that he knew a good deal more about what happened in the plane than he chose to say. During his examination-in-chief, he was directed to put on his leather coat, sit down in a chair, the pistol in the left-hand pocket, to put his left hand on a stick to represent a joy stick, and to draw the pistol from his pocket. On this being done, the muzzle pointed directly towards the hole in the sleeve. The end of the trial was, that he was acquitted of both charges.

The case goes to show how a prosecution can be upset by an inaccurate and hasty examination by a medical witness, how any inferences drawn are worthless, and how divergent statements by medical witnesses can be used by the defence to support their side, and how valuable it is to reconstruct as far as possible, the events, and then see how far they point to an accurate and logical conclusion.

In all cases under these sections of the Army Act, where wilfulness is an essential ingredient, there must be evidence of motive. Motives can be inferred from previous overt acts, conduct and words. The mere fact of a man being in a potentially dangerous position is not enough. To bring guilt home to the prisoner motive must be proved, and the chain of circumstances must be such as to lead to a conviction of guilt in the minds of those trying him. The officers of the court martial are both judges and jury. They have the assistance, where possible, of counsel sitting as assessors with them, and the prisoner has the benefit on conviction of having his case afterwards reviewed for confirmation or

revision by higher authority. It would be an advantage if an experienced medical officer, preferably with a legal training, were a member of the court, or at any rate of the reviewing authority, in important cases where the death penalty, penal servitude, or cashiering is involved.

Note.—This paper has dealt with procedure under the Army Acts. The rules of evidence in all courts martial, whether naval, military, or air force, to be followed, are those adopted in courts of ordinary criminal jurisdiction in England.

Discussion.

An interesting discussion took place after Colonel Warrack's paper in which the following took part: Sir William H. Willcox, K.C.I.E., C.B., C.M.G., Major-General Sir Wilfred W. O. Beveridge, K.B.E., C.B., D.S.O., Air-Commodore David Munro, C.B., C.I.E., Surgeon Commander T. B. Shaw, R.N.

Sir William Willcox said: The determination as to whether a firearm wound was self-inflicted was often extremely difficult. In 1916 some experiments with the Service rifle were carried out by me at the request of the War Office. The results of these experiments were published in June, 1916, in the Journal of the Royal Army Medical Corps. In 1908 a paper on the medico-legal importance of wounds produced by firearms was read by me before the Medico-Legal Society. When the muzzle of the firearm is near to the body fired at the character of the wound will often indicate the actual distance of the muzzle from the object. It is necessary to know the weapon used, and also the type of bullet and the powder, and whether ordinary gunpowder or smokeless powder. Preliminary experiments made by firing at white cardboard at distances of 3, 6, 9, 12, 18 and 24 inches respectively are helpful. The presence of blackening, scorching and peppering or tattooing around the inlet wound will generally enable one to form a fairly accurate opinion as to the distance of the muzzle from the object, assuming that this is under two feet. Also the character of the wound itself, and the presence of powder in the deep tissues is of importance. The direction and the situation of the wound are also obviously of great importance. When all these factors are carefully considered, the possibility or probability of a wound being self-inflicted is made clear. Usually collateral evidence is necessary before a definite opinion can be formed, also the mental condition of the suspected person is of great importance. A wound may be purposely or accidentally self-inflicted and the determination of this is one of great difficulty. In the case quoted by Colonel Warrack there did not appear to have been any sign of blackening or tattooing on the surface of the coat through which the bullet passed, it therefore appeared that the distance of the muzzle was probably over one foot from the inlet puncture in the coat. This being so, the probability is that the wound was accidentally self-inflicted. Colonel Warrack's paper was of great interest since

the mental condition of the accused person undoubtedly was an important factor in the case. It would be of interest to know if the accused person had ever suffered from epilepsy, or if there was any family history of this disease. The lack of memory occurring at the time of the accident suggested the possibility of a post-epileptic state, or a condition such as larvated epilepsy. The trial of a person accused of self-inflicted wounding on active service was one of great difficulty, and few medical officers were willing to state that a wound *must* be self-inflicted, and still less say that it was wilfully self-inflicted. In cases of this kind the scientific evidence and deductions should be placed before the court martial, and the decision based on the facts available left with them. In Colonel Warrack's case a correct verdict was, in my opinion, obtained.

Major-General Sir Wilfred W. O. Beveridge gave some experience of some self-inflicted wounds among the Indian Expeditionary Force during the war. He also stated how rare suicide was in the late, as compared to the South African, war.

Air-Commodore David Munro stated that in the Indian Expeditionary Force other methods adopted to avoid service in the trenches were the causing of conjunctivitis by the introduction of foreign bodies into the eye, as well as the production of an abscess of the leg by introducing a needle fouled with fæcal matter. This latter method was accidentally discovered by the finding of a piece of thread.

Surgeon Commander Shaw, R.N., said that during the war he had spent some time in the North Sea, the rigorous conditions of which were only too well known, but in spite of this fact, in his experience, self-inflicted wounds were comparatively rare in the Navy.

Colonel Warrack, in his reply, stated that he had gone into the question of epilepsy with the accused, and that this was denied. As regards blackening, none was found on the coat of the accused.

A CORRESPONDENCE CIRCLE.

BY MAJOR M. B. H. RITCHIE, D.S.O.
Royal Army Medical Corps.

IX.

A ROYAL ARMY MEDICAL CORPS ANNUAL CONFERENCE.

MOST associations of professional men hold at regular intervals Conferences or Meetings, at which the recent work of their profession is discussed. An example is the Annual Meeting of the British Medical Association. In the R.A.M.C. we have no such Annual Meeting, nor, to the best of my belief, have any of our sister medical services.

Is it not time that we began to hold a similar Meeting, or Conference, annually? Limiting ourselves to subjects of professional interest, without touching upon military medical topics that could not be discussed in open assembly, there are many matters that require to be debated and demonstrated. Work in the various fields of research, clinical or scientific, wants to be stimulated, co-ordinated, and directed along the right channels; *liaison* between research workers needs to be developed. The medical legacy of the late war is a mass of unsolved problems that we must tackle some day, and it is the personal touch of an accomplished lecturer that sets one searching for solutions in a manner that the reading of articles can never do.

We want our interest in the various problems of military medical science stimulated; initially, we want to be shown that we have with us, in our midst, excellent opportunity for scientific investigation of disease and *health* conditions, which, up to now, we have not fully exploited. We want to hear lectures and discussions on the professional aspects of Corps duties, and join in them. We want to become articulate, and so be heard by the main body of the profession.

In these lean years of the *post-bellum* epoch—it deserves a nasty name —there is less scope for us on the military side of our duties than on the professional side. Activity in war research means some corresponding financial activity. That alone is enough to inhibit it. Administrative medical edifices may be shaky about the foundations, while professional are built up on solid rock. In these hard times, when anything may happen to us, our obvious line of development is towards the solution of professional problems that are vital to an army in war, and, also to a civil population in peace. Individually and collectively, we stand to gain more for the Corps by professional activity than by administrative. We have some first-class brains among us, we have a little spare time, and we dwell in the centre of a wide field of investigation and research. What more do

we want than an appreciation of the fact that we are capable of undertaking work which will raise our professional status, together with that of the Corps? A distinguished scientist, in a letter to me the other day, wrote the following: "There is no reason why a man should not distinguish himself and gain international reputation by his work in the R.A.M.C., for there are plenty of opportunities for research." Let us remember these words of encouragement.

To return to the Conference, if official it might be smothered at its birth under travelling claims: if on official subjects, under tomes of regulations. So it might have to commence as unofficial, and on professional subjects where opinions or discussion soar free and unfettered, where rank and grade are laid aside, and no one has administrative corns that may be trod upon by the unwary. Millbank is ours; afternoons in some week, perhaps near to the trooping season; surely with a little arrangement and stage-management it would be possible to make a success of the scheme, provided that adequate time was allowed for the preparation of addresses and papers, and that those best qualified came forward to assist. Properly launched, backed up by a solid body of our officers, with subjects selected that would prove of some interest to the civil profession and to the general public, a R.A.M.C. Annual Conference would do the Royal Corps a power of good.

Conferences are stimulating, and make for efficiency. It is customary to scoff at them, to talk of "hot air;" but at the present we are so reticent —so silent even to brooding—about professional investigation, that to let off "hot air" would be in the nature of a tonic. In France conferences were invaluable, as they were the best means of directing keenness and disseminating recent knowledge. A century ago the line beat the column; to-day the conference beats the memo.—every time.

It would help also towards maintaining a good standard of professional literature in our Journal. Papers and discussions become available for publication, and a supply of interesting contributions is thus assured, and there is another point. We must cultivate the acquirements of speaking in public and compiling scientific articles throughout the Corps, as they are acquirements that our officers should possess.

Call it a Conference, or call it a Summer School—its name does not signify. But let us think seriously about having one. News travels slowly around our widely-scattered stations, and the preparation of papers takes time; it would be necessary to look a year ahead at least. Indulgent reader, if you agree in principle to a Conference, let us get busy about it soon.

A correspondent sends the following:—

On Regulations.

The study of regulations is incumbent on every officer of His Majesty's Services, and twice at least in the career of a medical officer is this study

made a matter of necessity. Apart from these occasions, and certain times of difficulty and distress, the tendency is to regard official books with a feeling somewhat akin to despondency if not to alarm; *their very language breeds distrust*, and their very completeness engenders the suspicion that whatever you may say or do these "paras" will be used in evidence against you. And yet behind all the hard and fast phraseology lies much that is imaginative.

Of the books in general use, perhaps the second volume of Field Service Regulations is less read by us in the R.A.M.C. than most; it concerns only fighting troops, and we are told in our "training" that "any instruction in purely military questions, beyond what is required for the performance of his proper functions, must be regarded as superfluous for an officer of that (i.e. our) corps;" yet it is probably the most readable of all official books, except possibly some of the historical parts of the Manual of Military Law, and it can be applied—in part at any rate—to ourselves. We fight a continuous war, not only against disease, but also against indifference, and at times ignorance, and the general principles of any war, either moral or physical, are identical with the great principles enunciated and worked out in this volume. Let us consider ourselves, too, in the light of that very excellent second chapter and think whether we are, or are going to be, fit to lead in future wars?

Would it be going too far to say that the second-least-read of our common official books is the R.A.M.C. Training? And yet there is much sound knowledge and guidance contained therein, and evidence of high ideals too. The book, however, is unpleasing to the average medical officer by reason of the intimate mixture of board school anatomy and physiology, stretcher drill and nurse's first aid, with notes on field medical tactics and strategy, hygiene and so forth. Can we not have bound separately the nursing orderlies' "vade mecum" and drill, and a medical officers' "policy and tactics"? We have the basis of a sound medical service policy, but as yet it is nowhere collected as is the combatant policy in Field Service Regulations; the elements, indeed more than the elements, of it exist scattered through the pages of our Journal and various official publications; why can we not have it within one concise volume?

Clinical and other Notes.

A CASE OF INTESTINAL OBSTRUCTION DUE TO MECKEL'S DIVERTICULUM.

By Captain D. J. BATTERHAM, M.B., F.R.C.S.
Royal Army Medical Corps.

INTESTINAL obstruction in the following case was due to the free end of a Meckel's diverticulum forming a new attachment to the mesentery of the small intestines.

This caused an acute kinking of the ileum at the new point of attachment, and finally gave rise to complete intestinal obstruction.

The condition appears to be by no means common. Barnard [1] investigated a series of 669 cases of intestinal obstruction occurring in the London Hospital, and found Meckel's diverticulum to be the cause in only thirteen of these cases.

The same writer states that the type of Meckel's diverticulum which is most likely to produce intestinal obstruction, is the diverticulum which has formed a new attachment at its free end.

Cazin [2] collected twenty-three cases of Meckel's diverticulum forming a new detachment. In ten of these cases the free end of the diverticulum had attached itself to the mesentery of the small intestines.

Lieutenant X., aged 22, was admitted to the Military Hospital, Cologne, on November 8, 1924, at 4.15 p.m. He stated that two days previously, whilst playing billiards in the mess, he had a sudden attack of acute abdominal pain which was followed by vomiting. Since that time he had suffered from intermittent attacks of colic, and had vomited everything that he had taken by the mouth. His bowels had not been open since November 6, 1924.

On admission, the patient looked ill and was having attacks of colic—apparently intestinal—at fairly frequent intervals. His temperature was 99° F., pulse 64.

The abdomen moved freely with respiration and there was no rigidity or tenderness on palpation. There was no distension, and no cutaneous hyperæsthesia could be elicited.

A turpentine enema was given and some scybala were returned from the colon. A second enema was given two hours later with a similar result.

The patient passed a fairly comfortable night. The abdominal pain was much less severe and there was no vomiting.

In the morning he stated that he felt much better. His temperature was 98·4° F., pulse 80.

No action of the bowels resulted from another turpentine enema and no

flatus was passed. An injection of pituitrin one cubic centimetre was then given subcutaneously.

By the evening, the attacks of colic were becoming more frequent and the abdomen was slightly distended. There was no vomiting, but a persistent hiccough was noticed during examination. Evening temperature was 98° F., pulse 100.

In view of the fact that the bowels had not acted since the morning of November 6, 1924, and the abdomen was becoming distended, it was decided to do a laparotomy before the obstructive symptoms became more acute.

An injection of morphia $\frac{1}{4}$ grain and atropine $\frac{1}{100}$ grain was given. The patient was then anæsthetized with C. E. mixture followed by open ether.

The abdomen was opened through a para-median incision. The cæcum was first examined and found to be collapsed. The hernial orifices and the region of the umbilicus were next explored with the finger, but no cause for the obstruction could be found.

The distended coils of small intestine were then packed off with an abdominal swab and the collapsed gut was followed upwards from the cæcum. About two feet from the ileo-cæcal valve the ileum was found to be drawn inwards towards the spine and sharply kinked by what appeared to be a sudden shortening of the mesentery. Above this point the gut was distended and œdematous.

The thickened mesentery was carefully examined at the point of obstruction, and a Meckel's diverticulum was found embedded in adhesions. The diverticulum was patent for about two inches and was adherent at the tip to the upper surface of the mesentery, near its origin from the posterior abdominal wall.

The diverticulum was dissected away from the mesentery after dividing some adhesions. The process was then removed by crushing and ligaturing the base. The stump was invaginated.

The proximal loop of gut was œdematous and purple in colour but the serous surface was shiny. It was swabbed with hot saline and returned to the abdomen. The abdomen was then closed completely.

After the operation the general condition of the patient was good. Rectal injections of normal saline with glucose five per cent were given every four hours. Subcutaneous injections of pituitrin one cubic centimetre and eserine $\frac{1}{100}$ grain were given alternatively at four-hourly intervals with a view to starting peristalsis.

On the following day some flatus was passed after a turpentine enema, and the rectal salines were discontinued.

The second day after the operation the bowels moved twice.

On the third morning an ounce of castor oil was given and the pituitrin and eserine injections—which had been given at increasing intervals—were discontinued. During the day the bowels were open freely.

From this time onwards the patient's condition improved rapidly.

The abdominal wound healed by first intention, and the stitches were removed on the tenth day.

Two days later the patient had an attack of abdominal distension accompanied by vomiting. The superficial part of the wound burst open in the lower half. Secondary suture was done under novocaine and the wound eventually healed with a firm scar.

The patient was discharged from hospital to sick leave on January 1, 1925.

The case is of interest, firstly, on account of the comparative rarity of the condition, and secondly on account of the somewhat misleading signs and symptoms which it produced.

As there was no distension of the abdomen until three days after the onset of the illness, it would appear that the obstruction was only partial to begin with, and a certain amount of flatus must have been passed.

I am indebted to Lieutenant-Colonel R. Storrs, R.A.M.C., Commanding Military Hospital, Cologne, and to Colonel J. M. Sloan, C.M.G., D.S.O., D.D.M.S., British Army of the Rhine, for permission to publish the notes on this case.

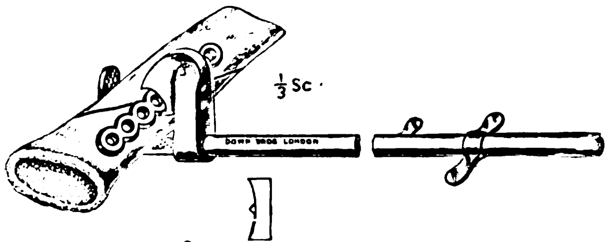
REFERENCES.

[1] BARNARD. "Contributions to Abdominal Surgery."
[2] CAZIN. "Etudes sur les Diverticules de l'Intestine."

A BONE AND PLATE CLAMP.

By MAURICE SINCLAIR, C.M.G., F.R.C.S.

THIS instrument has been devised to assist mainly at bone-plating operations, and with its use such operations are much shortened in duration and are greatly simplified, as the fragments can be securely held in their alignment, while the fracture is bridged by means of a specially modified plate (*vide* below) which is firmly gripped by the clamp or clamps to the upper and lower fragments of bone.



SECTION OF PLATE

The bone can now be safely and readily drilled and the plate secured by means of screws, without loss of alignment, without obstruction to vision, and without those encumbrances which so frequently take place during the fixation, especially of the initial screws.

The bone and plate clamp may be used singly or in pairs, one for each main fragment of a fracture. After the fracture has been repositioned, they clamp and hold the bone fragments and the metal plate *in situ* until no longer required, when they are easily removed.

The clamp used for the bones of the upper limb is similar to that used for the lower, but is of lighter construction.

A clamp consists, for descriptive purposes, of a male stem and a female tube and has an over-all measurement of fourteen inches for the lower limb.

The male stem is made out of $\frac{5}{16}$-inch round steel, is flattened and hooked at one end in order to aid the gripping of the bone, while the other end is threaded and has a key-way, slotted along the underside to prevent the hook from rotating when the instrument is being used.

The female tube is ten inches long and takes the male stem inside. At one end it has a jaw brazed to the outside, and at the other end it is fitted with a butterfly nut, which takes the threaded end of the male stem. The portion projecting beyond the nut is completely sheathed in a thimble of metal, in order to prevent undue destruction of rubber gloves.

The bone plates are a modification of Lane's, and the surface of the plate which is applied to the bone is concave, with a "kick up" (as it is technically called) between each hole.

These fit the convexity of the bone more accurately and the "kick ups" prevent slipping of the plate on the bone. When the plates are firmly gripped by means of the clamps greater security is obtained.

I consider an instrument and plate such as I have described to be essential in order to obtain the results detailed in the *British Medical Journal* of November 17, 1923.

I thank Down Brothers for the interest and care they have shown in the production of the clamp and plates.

A CASE OF FATAL HÆMORRHAGIC PURPURA FOLLOWING ADMINISTRATION OF SULFARSENOL.

By Captain T. P. BUIST, M.B.

Royal Army Medical Corps.

The following case is of interest, not only because fatal hæmorrhagic purpura is uncommon, but also because purpura as a toxic effect of arseno-benzol administration has attracted relatively little attention.

The patient (Trpr. S. G. S., 8th Hussars) was a trooper of nineteen years' service and 37 years of age, and had been under antisyphilitic treatment since July 17, 1922. The history of the original sore is indefinite, the only clue being a small labial scar of what had been considered a tropical ulcer in Mesopotamia about two years earlier.

He had been attending at the Military Hospital, Canterbury, since January 4, 1924, and had received there a seven-dose course of sulfarsenol and mercury and, after three months' rest, five injections of a further course without showing any notable signs of intolerance.

The Wassermann reaction was full positive on January 4, 1924, but was negative on May 5, 1924 and August 11, 1924. There were no signs of subthyroidism, and no history of hæmophilia.

The sixth injection, 0·60 gramme sulfarsenol I.M. and mercury 1 gr. I.M., was given on November 3, 1924. Next morning he stated that an hour after the injection his gums began to bleed, and that a little later a slow bleeding from the nose commenced. On examination, four small hæmorrhagic bullæ were seen on the tongue, and blood was still oozing from the gums and nostrils.

On the following day a purpuric rash had appeared on the thighs, legs and arms, with large ecchymoses at the sites of the two injections.

Two days later, hæmaturia commenced, and on the sixth night blood appeared in the stools.

On the seventh morning fresh bullæ appeared in the mouth, including one large one on the left anterior faucial pillar. Paresis of the left side of the face developed during the day, the patient became drowsy, and in the evening unconscious. He died the same night.

The post-mortem examination revealed the following conditions: Generalized non-inflammatory congestion of both lungs, except for a portion of each upper lobe which was normal.

Petechial hæmorrhages and hæmorrhagic areas in the lips, skin, wall of left ventricle, stomach wall, mesenteries and great omentum, and large and small intestines.

Both kidneys were hæmorrhagic, with clots of blood in the pelvis; the right kidney showed also subcapsular hæmorrhages at both poles, and the perirenal tissues were hæmorrhagic.

The pleura, pericardium, large vessels, and the liver showed no hæmorrhages.

When the cranium was opened, the dura was somewhat injected, the cerebrospinal fluid was blood-stained, and the base of the brain showed a few superficial petechial hæmorrhages. The right Rolandic area was somewhat congested. The right temporo-sphenoidal lobe contained a mass of softened brain tissue and blood, and the right ventricle was greatly distended with blood. The remainder of the brain appeared to be normal.

In a note on the toxic effects of arseno-benzol in the *Medical Annual*, 1924, Harrison indicates purpura as one which has attracted comparatively little attention, and refers to the experiments of Anwyl Davies and Mellanby, who found that blood coagulation is delayed by the action of arseno-benzol on the fibrinogen, an effect usually transitory *in vivo*. They found also that stabilarsan does not produce this effect, and they consider that the particular group in arseno-benzol which has this anticoagulent

effect is blocked or satisfied by previous combination with the glucose which is present in this preparation.

Rabut and Oury (*Presse Médicale*, September 20, 1922) record two fatal cases of hæmorrhagic purpura after novarsenobillon. In discussing this form of arseno-benzol poisoning they draw attention to the occurrence of purpura in workers exposed to benzol, and suggest that the benzol combination rather than the arsenic is a possible cause.

A recent case has been reported by C. M. Smith (*Arch. Derm. and Syph.*, February, 1925), following the administration of arsphenamin and mercury. In this case there was bleeding from the nose and gums after the twenty-third injection, and after the twenty-fourth profound collapse, cyanosis, weakness, and more severe bleeding from the nose, gums and rectum. The case survived.

I am indebted to Major F. Casement, D.S.O., R.A.M.C., for permission to use extracts from his report on the post-mortem examination, and to Major F. C. Sampson, D.S.O., R.A.M.C., for permission to record the case.

Travel.

A VISIT TO HONDURAS—AND RETURN.

BY MAJOR A. W. HOWLETT.

Royal Army Medical Corps.

(WITH PHOTOGRAPHS BY THE AUTHOR.)

THERE are no R.A.M.C. in Honduras, but in spite of this defect it considers itself a civilized country and counts itself in the comity of nations. The Honduranians know, for instance, that Lloyd George is King of England. They have also heard of Mary Pickford. They told me this themselves, not in any spirit of display, but as men of the world talking to another man of the world. Although on first landing and seeing everyone a miniature walking arsenal, one might form the impression that the life insurance companies were not out to do big business hereabouts, one would be wrong to jump to the idea that lawlessness is prevalent. There is no crime in Honduras except being on the wrong side in politics. That is indeed a serious misdemeanour.

To give you an instance. On our first arrival we were medically inspected by a coloured gentlemen of the name of Dr. Jameson, and after he had been duly regaled by the chief steward, and I had sought in my most interested manner to exploit his views on yellow fever, of which he appeared never to have heard, we shook hands and parted with mutual hopes of seeing one another next time. I never saw Dr. Jameson again; nor was it any defect in his appreciation of yellow fever that had lost him

his job. When I came back, some six weeks later, there was a new port doctor. When I inquired of the new port doctor what had happened, he smiled, much as a child might smile when asked by a suspicious mother what had become of the jam, and then replied with a touch of irritation at the colossal stupidity of the foreigner: " There has been a revolution since you were here."

Railway sidings for assembly of banana trains.

A banana-loaded truck.

So apparently my friend Dr. Jameson had to go on the dole, or, what is the same thing in Honduras, retire to the forest where doubtless, though his professional acquirements may become a little rusty and even suffer a total eclipse, he will possess himself in patience until word comes that the " right side " is up again.

Honduras is the most backward of the Central American republics. It has no roads and the only means of getting about is by the railways with which the great United Fruit Company has interpenetrated the bush. The coast is of a savagely tropical aspect with a low littoral fringed with

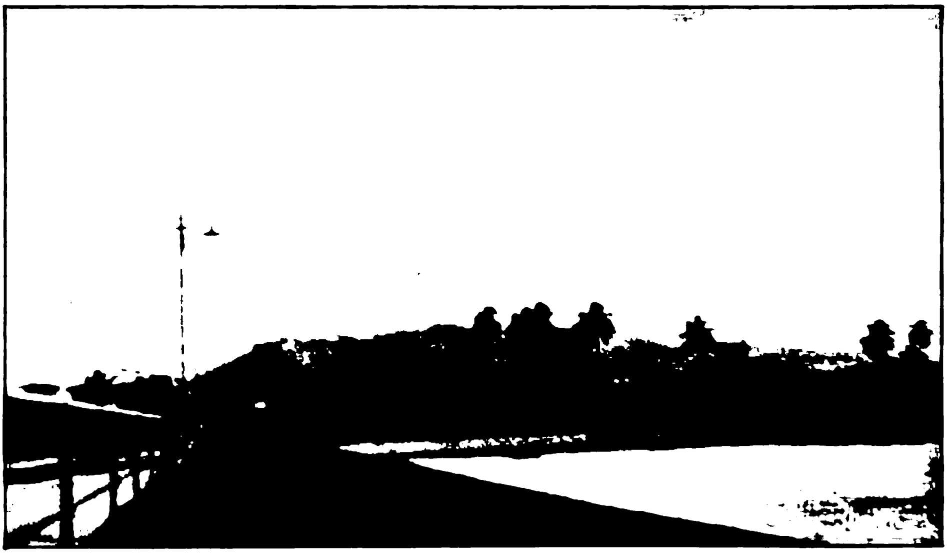
palms, like the tassels on an antimacassar, and in the hinterland an uplift of rocky heights clad in tangled masses of verdure. When I first beheld it, it was in the grip of a tropical storm, it being near Christmas and the season of the rains. The palm trees along the shore were writhing like bacchanals, and gigantic swathes of woolly mists rolled and unrolled adown the mountain sides. Nevertheless, I went ashore having all the curiosity of a schoolboy to explore this enchanted land where, as it seemed, real pirates might be lurking in every bush. I have never been a pirate and no one except the paymaster has ever credited me with piratical instincts ; but if wild nature can be held guilty of impelling to piracy, if it is ever morally justifiable to be a pirate, then, thought I, this is the venue. The rain came

Up-country ranch showing rain-water butts.

down as if from a thousand hoses, and the long wooden jetty, where the train-loads of bananas come roaring and rattling down to the ship, was all awash with puddles up to the knees.

The town was in two halves, a muddy creek which slid in slimy shallows over the beach dividing them. On the left was the old Spanish town, inaccessible at the time as the revolution was going on in it and the streets were not healthy ; on the right was the new foundation of the fruit company. And this was a creation worthy of a little study by those interested in tropical architecture. It may be taken as an axiom that the American in " Little Ole Noo York " knows the art of living, and he does not lose much of it when he goes abroad. Not for him the old Indian bungalow with its mud walls and cracked doors at an annual rental of one-third its original value, its asylum for old and infirm snakes in the roof and

its shelter for working centipedes in the cracks of the plaster. I made my way to the house of the padre, whither I had been invited, and, albeit it was a spot lately reclaimed from the clamant jungle, which here will engulf an Olympia if it is left to it for a fortnight, I found trim paths of asphalt with the grass and herbage nicely clipped and channels for the escape of surface water. The house itself was built on piles some four feet above the ground. Like all the other buildings in the settlement, it was painted a dirty mustard yellow, a hue unbeautiful enough, but one which I was assured had been found after much experimentation to reduce the temperature two degrees below any other. A verandah ran all round the house closely gauzed in against mosquitoes. Within this again doors and



Honduras coast in a gale.

windows were similarly protected. A mosquito did not stand a dog's chance. Indeed, those insects seemed to have gone out of business. I never even saw one in this locality though there were plenty up-country.

To one familiar with the barnlike structures in which the European lives in India the comfort of this dwelling was amazing. Inside was an electric stove, and the kitchen replete with ice chest, milk pail, meat safes, etc., would have delighted a Kensington flat-wife. There was a sort of communal cold store so that fresh meat and vegetables could be drawn as required. Altogether I could not help thinking that here was a model of what a tropical cantonment should be, and I am bound to say it left me with a sense of no little bitterness to recall the conditions under which the British officer, whether military or civilian, is expected to carry on the great traditions of his race and stand as "ma-bap" to a population of

dependent millions. I think I can see one of the officials of the great fruit company being asked to hang up his hat in a typical Indian bungalow. "Say Bud, I don't reckon to be over-partic'ler, but I ain't a caveman. Ever hear of mosquitters? Maybe yer can't help one or two in yer bunk now and then, but I don't reckon to marry them," and so on.

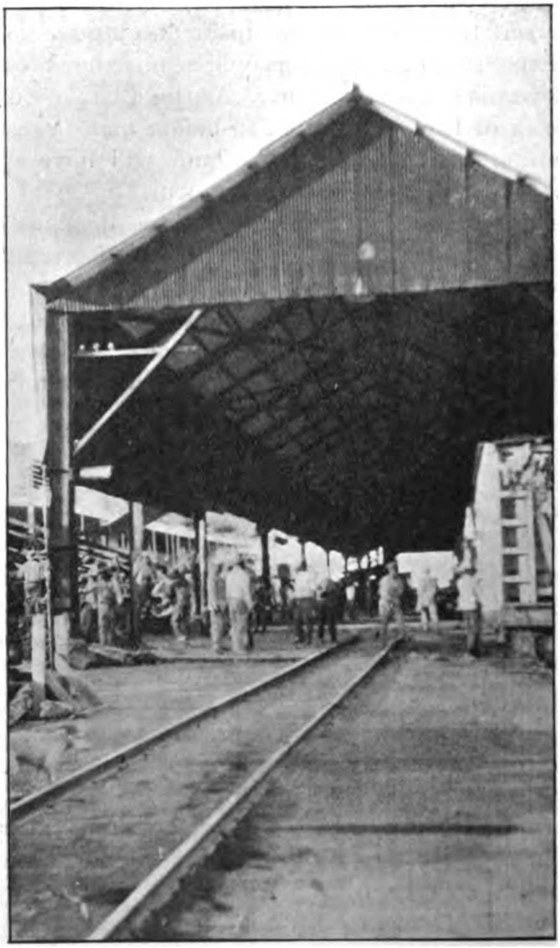
One wonders if the world at large realizes that America is rapidly committing herself to the establishment of an empire, and that in spite of herself. The expansion of a great people seems inevitable whatever their predilections towards self-centrement. As the British Empire grew out of the fierce rivalries of the spice trade, so before many decades are overpast an American empire, in fact if not in name, will have sprung out of the banana trade. The magnitude of this fruit business is bewildering; practically the whole being of Central America depends on it. And the West Indies themselves, even those under nominal British suzerainty, are coming rapidly under the domination of United States finance.

It is no very hazardous prediction that the close of this century will see the whole of America, from the Canadian frontier to Ecuador, a congeries of closely-knit States indistinguishable from an empire in all but the name.

The railway track, which appeared to be about metre gauge, as it is in all the republics hereabouts, which owe their railways to American enterprise, threads all the coastal lowlands and the valleys up-country. Save where the land has been cleared for bananas, it is hedged in closely by the jungle. A special apparatus like a "Flammenwerfer" is attached to a railway truck, and once a fortnight or so is drawn through the forest to scorch with its dragon breath the ever-encroaching growth which, but for this, would speedily engulf the track. The train rocks and sways on pile-built viaducts over morasses wherein lies buried the decay of centuries; and it is no exaggeration to say that if it were to stop anywhere except at a clearing it would be impossible to get out of it, so dense are the forest walls around it.

It is a wonderful thing to sweep on through the mystery of these forest walls, and to know that hundreds of furtive eyes are watching you from the sun-shot shadows, eyes of jaguars, pumas, ocelots, pythons, deer and monkeys; to count the parasites that hang from the boughs, and the magnificent trumpet-flowers that waste themselves in a prodigality of unrecorded splendour; to experience that enthralling sense of trespass into domains that were never meant to be sullied by the footsteps of mankind. I spent a day in a ranch up country. It was like walking into a book of old adventure stories, such as we were regaled with in our young days by "Kingston or Ballantyne the Brave." It was the mess of about a dozen cowboys, and each one as he came in unslung his revolver and belt of cartridges and hung it on a hat-stand beside the table. The meal was served by a coal-black mammy of prodigious proportions who went by the name of Doris. We drank rain-water, which was collected off the roof into

a great water-butt, and though it was brown and slightly mawkish, it appeared to do nobody any harm. Water there was in plenty in the pools and swamps, but that, of course, was unfit to drink, and was only used for washing. Like the bungalows on the coast the whole hacienda was mosquito proof. After lunch we sat in the verandah in easy chairs enjoying



Banana loading quay.

the soft caresses of the sea breeze which set the palms astir with a murmurous somnolence. In the evening we repaired again to the ship which during her stay in the bay was converted into a sort of palais de dance. There were American schoolmisses there who, though they had been two or three years in the settlement, might have just stepped off a street-car in Broadway, so fresh and unspoiled were their complexions. In that equatorial climate no further proof was needed of the completeness and efficacy of American methods of tropical hygiene.

On the shore were miles of railway sidings, with many repair shops and workmen's dwellings, all painted the same dull monochrome, where the long banana trains gathered overnight. All day long the tireless locomotives were picking up the lines of laden trucks and rushing them on to the quay. They were loaded with all speed, for speed is everything in the banana trade, and stowed away in the holds. We had a hundred thousand bunches on board when we sailed. Nothing could exceed the care lavished on them. Special holds were arranged for their bestowal, carefully ventilated, and kept at a uniform temperature of 58 degrees all the voyage. Every three or four hours the temperature of the sea was taken —for one is apt not to realize that the heat inside a ship is closely affected by that of the sea, more than half of the ship being under water—and the refrigerating machinery adjusted accordingly. The walls of the cabins and corridors used to sweat so that pools collected on the floors with the condensation of the humid, tropical air against their chilled surfaces.

With memories of terrible days and nights in India, when men used to die out of hand under the flaming sun and the creeping pre-monsoon humidity, I wondered if it would not be possible to instal in Indian stations some similar devices, if, in short, it might be possible to expend on human beings some of the tenderness which is lavished on bananas. I went into the question with the chief engineer, but came to the conclusion that under the present regime in India the expense would be prohibitive. Nevertheless, I am still of opinion that a modification of the system would be feasible. A powerful engine, quite independent of the machinery of the ship, compressed air to a pressure of 200 pounds to the inch, and the sudden release and expansion of this produced great cold. It was strange to pass from the sweltering mid-day heat into that room and find snow lying on the deck and pipes swathed in ice. The cold air was driven through all the holds by powerful fans, being further cooled or kept cool by passing over sets of pipes filled with sal ammoniac.

It would not be needful or desirable to bring the temperature down to 58°, but even if one could attain to 75° much would be gained, and it should not be beyond the capacity of engineers to produce a modified form of the plant which could do this. It does seem strange that men have had to wait for the development of the banana trade to evolve a method that might have saved them an infinity of suffering, or that they should let themselves perish for want of the attention which they can give to a fruit.

Looking over the ship's side on to the quay was like a glimpse into filmland. Only here it was the real thing. All who could afford them wore revolvers with miniature ammunition dumps attached to their persons. Those less well-to-do wore "machetas," an instrument between a bowie knife and a bayonet. Probably this was the more useful of the two, as it was indispensable for hacking a way through the forests and was useful besides for chopping firewood. A "soldado" (anglice soldier) represented the might and majesty of Honduras. Every time I stole a glance over

the bulwarks I found his ancient Remington pointing at my face, which discouraged me from any but cursory investigations. I should say he had not drawn any clothing allowance for the last ten years, nor had his laundry been any serious burden on the public funds. However, the cost of living in Honduras, so far as mere living is concerned, is not great, a few banana leaves for a habitation and bananas for sustenance being all

Banana train passing ranch.

that are required. Down the coast I was told of a certain old castle into the vaults of which the sea came at high tide. This fulfilled the dual purpose of a condemned cell and execution dock. People who are so improvident as to be executed in Honduras—and you must be peculiarly friendless and penniless to run such a risk—are committed to this duress, and the first high tide does the trick. Thus the State is saved the expense

of an executioner. And it may be remarked that the State is not unduly exuberant in its outlay on the processes of justice. The agent who ran the experimental gardens of the company was telling me how he ran in a man whom he found stealing his coconuts. He was present in court when the commissary sentenced the delinquent to a term of imprisonment, and, such thefts having been common of late, congratulated himself on securing the conviction. His satisfaction was much damped by running across the convict the same afternoon strolling at large in the street of the native town. He complained to the commissary, who appeared to be much annoyed at his interference, and told him with some acerbity that he could hardly expect the State to be put to the expense of keeping a man in prison for stealing a foreigner's coconuts, but that if he liked to make himself responsible for his charges he would see the man jailed for as long as he liked.

As in all these Central and South American republics, the population is made up of three elements so insensibly graded that the colour bar ceases to have any meaning, and black, brown and white intermingle promiscuously. There are the old Caribs who still contrive to maintain a certain tradition of race purity, the negroes and the Spaniards, or Lusitanians. Possibly some of them indulge secret dreams of ancestry and tell their grandchildren stories of forebears who came over with the conquistadores; but they make no parade of it.

No, Honduras is splendidly democratic in the way that only Latin peoples seem capable of understanding the term. The Anglo-Saxon race can never rise to the full conception of it. Your Hyde Park orator damning the whole crowd of bloated aristocrats, would accept a coronet to-morrow if it were offered him, and his whole turgid flood of invective, had he the brains or patience to analyse it, is nothing but the unconscious expression of his repressed jealousy. But I must not forget there is a small quota which calls itself British, and takes a not unreasonable pride in its shadowy nationality.

We passed a small island out in the Caribbean about four hours before we terminated our voyage at the door of Honduras. It was called Utila, a charming blot on the seascape, for it appeared a very Utopia for Robinson Crusoes, and might have been Juan Fernandez itself. It had crescent beaches of white sand and dipping palm trees, and inland, criss-cross valleys filled with verdure and a miniature mountain range. My heart warmed to it, and the more when I learned that it had belonged not many years ago to Britain. The inhabitants still nourish a great bitterness at our abandonment of them. There is this much to be said of them, the fruit company are very eager to enlist their services on the mainland.

But I found many young Englishmen in Honduras in the service of the great fruit company, most of them public schoolmen. For the astute American knows the market value of the English public schoolboy, and one of them freely admitted to me that they could get no similar product

from America, capable of handling the native population with the same tact and efficiency.

It struck me as a delicious irony, that I had to wait to hear this encomium from an American, even though one has grown a little hardened to the diatribes of half-educated Indians and Egyptians, and the malignant aspersions of some of our own countrymen upon those of our race who have given their days to the thankless burden of Empire.

Current Literature.

Dysentery in Federated Malay States. (No. 19.) Abstracted from "Studies from the Institute for Medical Research," Kuala Lumpur. Federated Malay States. By William Fletcher and Margaret Jepps, 1924.

The Vitality of Dysentery Bacilli in the Fæces.—The prejudicial effect of delay in the examination of dysentery stools is notorious; yet delay is sometimes unavoidable. The following experiments were undertaken by us in England, during the year 1918, to determine how long dysentery bacilli will live in the fæces.

Shiga's Bacillus.—Fifteen samples of fæces, from five patients with acute dysentery of the Shiga type, were kept at room temperature in glass vaseline pots with screw tops, and examined every day. The result was that, in ten of the fifteen samples, dysentery bacilli disappeared within twenty-four hours; in four they were present on the second day, and, in one, they survived until the third.

Flexner's Bacillus.—Flexner's bacillus lived considerably longer in the fæces than the Shiga type of organism. Thirty-two samples of fæces, from five patients, were examined. In more than half the specimens the organisms persisted for more than a week, as compared with a maximum of three days for Shiga's bacillus. The longest period during which they survived in any stool was twenty-seven days.

But though the bacilli persisted for more than a week in most of the specimens, they were not found at every examination which was made during the time they remained alive in the fæces; the reason for this was a sudden drop in the proportion of dysentery bacilli during the first thirty-six hours, which, in the case of twenty-five specimens examined, amounted on an average to about 60 per cent. This shows how important it is that bacteriological examinations should be made with as little delay as possible. Moreover, it should be noted that the specimens of fæces with which we were working were not whole stools containing much fæcal matter, but they were samples of mucus, or of blood and mucus, which had been specially selected from them. The presence of fæcal matter and the resulting acidity quickly destroy dysentery bacilli. In a hot climate delay

is even more fatal to success; as a rule all dysentery bacilli disappear within twenty-four hours.

Experiments with Teague and Clurman's Solution.—Teague and Clurman (1916) found that typhoid bacilli can be kept alive in the fæces by emulsifying the latter in a solution of glycerine, and they recommend that, when it is necessary to send the fæces of typhoid patients to a central laboratory for bacteriological examination, the fæces should be mixed with a fluid consisting of 30 per cent of glycerine in sterile 0·6 per cent sodium chloride solution. About one part of fæces should be added to two parts of the fluid. They claim that this procedure "obviates the inaccuracies of diagnosis resulting from the usual delay in the arrival of specimen at the laboratory" and that "the proportion of typhoid to other bacilli is not altered for a week or more."

At the suggestion of Sir Frederick Andrewes we carried out experiments to determine if dysentery bacilli will survive longer, when the fæces are emulsified in Teague and Clurman's solution, than in the untreated excreta. The investigation was carried out with seven specimens of fæces from a man who was suffering from acute dysentery of the Shiga type. In most of the specimens Shiga's bacilli survived much longer when the fæces were emulsified with the glycerine solution than they did in those which were not treated in this way. In two cases the organisms died out as quickly in the emulsion as in the plain fæces; but in the other five, they survived in the emulsion for twenty-nine, seventeen, thirteen, nine and seven days respectively, a considerable prolongation of life over the maximum of three days in the plain fæces.

It was found that, even in the glycerine emulsion, there was a considerable fall in the percentage of dysentery bacilli during the first thirty-six hours, so that they became more difficult to discover and were not found regularly at each examination, but were isolated on sporadic occasions up to the last time on which a specimen was found "positive."

We also emulsified in the glycerine solution twenty-three specimens of fæces from patients with dysentery of the Flexner type and, as a control, a part of each stool was kept without the addition of glycerine. In the former the life of the dysentery bacilli was much prolonged; on an average they lived more than thirty days. In the case of one sample the bacilli lived for nine days in the plain fæces, but lived for forty-two days in the portion which had been emulsified in glycerine.

We have already drawn attention to the fact that these experiments were carried out in England in a laboratory with a temperature of about 15° C. More recently we have repeated them in Kuala Lumpur, where the temperature is approximately 30° C., and the results have been the same. In dysentery of the Shiga type, no organisms were isolated from plain samples, without glycerine, which were more than twenty-four hours old; except in one instance, where they were found as late as the fourth day. On the other hand, when fresh samples were mixed with glycerine, the dysentery

bacilli survived for a much longer period; they were isolated up to the thirteenth day from one specimen and up to the sixteenth day in another.

Teague and Clurman's Solution in the Field.—A small epidemic of dysentery, which occurred in a very remote corner of the Malay States, illustrates the practical value of this method in the field. The district involved is situated on the borders of Pahang and Johore, nearly fifty miles from the nearest little town, and very difficult of access. Some of the villages in which the outbreak occurred are five or six hours' journey apart by river, which is practically the only means of transport. An expedition from this laboratory would have occupied a great deal of time and cost a good deal of money. Fortunately Dr. Leicester, the medical officer, had heard of the value of Teague and Clurman's solution. He collected suitable specimens (blood and muco-pus) from three of the patients, mixed them with the solution and forwarded them to the laboratory. The specimens were respectively six, seven and eight days old when they were plated, yet Shiga's bacillus was isolated from each of them. This certainly could not have been done in a tropical country without the use of a preservative solution.

The use of Teague and Clurman's solution, and the care which the medical officer took in collecting suitable specimens, enabled a diagnosis to be made without the trouble and expense of an expedition. H. M. P.

Investigations upon Flagellate Infections. By Richard P. Strong (*American Journal of Tropical Medicine*, vol. iv, July, 1924).—The author discovered flagellate parasites in the latex of three species of Euphorbia, viz., *E. hypericifolia* and *E. pilulifera*, and one other all of which are annual herbs found in Central and South America.

In a certain district of Panama almost every Euphorbia plant was found infected. The infected plants showed pathological changes, the flagellates causing alteration in the appearance of the latex, disturbances in the circulation of the plant, and sometimes they formed emboli in the lactiferous channels resulting in atrophy of the plant. The flagellate is of the leptomonas type resembling the flagellate stage of *Leishmania tropica* and may be found in any part of the infected plant where a drop of the latex can be expressed.

The body of the parasite varies from 11 to 20 μ in length and has a maximum width of about 1·5 μ to 2·5 μ and contains an eliptical nucleus and a sperical blepharoplast situated near its anterior or flagella end. It multiplies in the latex of the plant by longitudinal division. The parasite as taken from the plant is not pathogenic to experimental animals.

It was observed that towards the late afternoon and just before sunset these plants were visited by a hemipterous insect, a species of the Coreidæ or land-bug, *Chariesterus cuspidatus*, which is not a blood-

sucking insect. Examination of the contents of a portion of the alimentary canal of these insects showed that they were frequently infected with the same flagellate, and "clean" insects acquired infection with the flagellates when fed on infected Euphorbia in the laboratory. Experimental animals could not be infected by inoculating them with the flagellate as it occurs in the intestinal canal of the insect host.

Numerous small lizards (*Cnemidophorus lemniscatus gaigei*) were seen to prey upon the insect hosts of the parasite, and in one out of nine lizards dissected there was found in the posterior intestine a heavy infection of a parasite morphologically identical with that observed in either the Euphorbia or Coreidæ; and the foregut of this lizard contained the crushed remains of these insects.

Experiments were then undertaken to ascertain if mice, puppies, guinea-pigs, and monkeys could be infected with the flagellates as they occur in the intestines of the lizard.

In the case of the monkey inoculated with 0·6 cubic centimetre of a suspension in normal saline of a portion of the contents of the large intestine of the lizard containing numerous flagellates and post flagellate forms, a small papule appeared at the site of inoculation in the skin eight days after inoculation; this papule broke down into an ulcer having the appearance of Oriental sore. Smears taken from the granulomatous portion of the ulcer on the sixteenth day after inoculation contained numerous parasites resembling forms of *Leishmania* found in Oriental sore. No forms of the parasite were found in the blood of the monkey. At the autopsy all the organs appeared normal and no *Leishmania* form of the parasites could be found in the blood, spleen, liver, or bone-marrow.

The author has shown that the insect *Chariesterus cuspidatus* can transmit a plant flagellate to a species of lizard and by extensive experiments upon animals he claims to have demonstrated that the flagellate as it occurs in the plant and also in the intestinal tract of the insect is not pathogenic for vertebrates, but that after the flagellate has passed through the insect to the lizard it acquires pathogenic properties and gives rise to a form of tropical ulceration of the skin in monkeys, and that in this ulceration the *Leishmania* form of the parasite and not the flagellate stage is encountered. The author refers to Perry's paper, recently published, on the presence of large numbers of the parasites *Herpetomonas donovani* in the villi of the mucous membrane of the intestine in a case of kala-azar.[1]

A. E. H.

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[1] Journal of the Royal Army Medical Corps, 1922, No. 39, p. 324.

Reviews.

MODERN OPERATIVE SURGERY. Edited by H. W. Carson, F.R.C.S. Two vols. London: Cassell and Company, Ltd. Vol. I, pp. xiii + 784. Vol II, pp. xi + 784. Price £3 3s. net.

The authors of these two volumes have produced, in a compact form, a sound and reliable guide for the operating surgeon in almost every branch of surgery.

The operations of general surgery are fully described and well illustrated. Anæsthetics, heliotherapy and radio-surgery are also dealt with, while the addition of sections for operations on the eye, ear, nose and throat, plastic surgery, and for gynæcological operations render the work very complete.

Each author is a recognized authority on the subject he deals with, and the two volumes contain a wealth of information which should make them a valuable addition to any operating surgeon's library.

The section on anæsthetics describes the various inhalation methods of inducing anæsthesia, and also gives the technique for spinal and sacral analgesia. In the paragraph dealing with restorative measures in collapse during anæsthesia, the details of cardiac massage are clearly described.

The part dealing with the treatment of surgical tuberculosis by conservative methods, and the rôle of heliotherapy in the treatment of tuberculosis, is full of interest; and the methods advocated by the author will influence the treatment of this disease to an ever-increasing extent as the value of sun-treatment becomes more widely recognized.

In the description of the operation for the removal of the semilunar cartilages from the knee-joint the author advises the application of a tourniquet round the thigh during the course of the operation.

Some surgeons may consider the use of a tourniquet for this operation unnecessary, and many would prefer to remove the tourniquet before the closure of the operation incision.

The occurrence of hæmarthrosis after this operation would appear to be more easily prevented by the securing of all bleeding points before the closure of the operation incision, than by the application of a firm bandage recommended in this article.

The operations on fractured bones are well described and fully illustrated. The author holds the view that plates and screws, when used in the treatment of fractured bones, should be left in position and not removed in the majority of cases. Many surgeons, however, consider that the plates and screws act as foreign bodies, and should be removed when consolidation of the callus has taken place.

Except in the case of the fractured patella, or olecranon, the author is not in favour of wire sutures.

On this point some surgeons are likely to differ from the author.

Wire sutures have the advantage of being small in size, and if left in position are less likely to cause discomfort than a plate and screws. They can often be introduced with less local disturbances of the soft parts, and for many fractures of the long bones are considered preferable to plates by some surgeons, provided the limb is well secured in a Thomas' splint after the operation.

The section dealing with the relative values of operation, X-rays and radium in the treatment of malignant diseases will be read with great interest.

The respective rôles which these agents should play in the treatment of malignant disease, in the present state of our knowledge, are well laid down by the author of this section. C. C.

PYE'S SURGICAL HANDICRAFT. Bristol: J. Wright and Sons, Ltd. 1924. Pp. xvi + 619. Price 21s. net.

The ninth edition of this book is edited and largely re-written by W. H. Clayton-Greene, C.B.E.

Intended by the original author as a practical book of guidance for house surgeons and dressers, and not as a textbook on surgery, the latest edition of the work still fulfils this object, although its scope is increased by the inclusion of some of the latest surgical methods.

The rationale and technique of blood transfusion are explained, and excellent short articles on the Wassermann reaction, the newer methods of treatment of syphilis, and the use of the cystoscope are included in the volume.

In the chapter on fractures, the use of the internal angular splint is recommended for the treatment of fractures of the radius and ulna below the insertion of pronator radii teres; in the opinion of many surgeons all fractures of these bones are best treated in full supination.

Also, under the treatment of fractures of the tibia and fibula, no mention is made of the Sinclair footpiece, so invaluable for obtaining foot extension.

The book, however, contains much practical advice and is one that every house surgeon or senior dresser should find of real assistance.

H. C. S.

A SYSTEM OF RADIOGRAPHY: WITH AN ATLAS OF THE NORMAL. By Ironside Bruce. Second Edition by J. Magnus Redding, F.R.C.S. London: H. K. Lewis and Co., Ltd. Pp. xii + 98. Illustrations 197. Size oblong Imp. 4to. Price 30s. net.

The main conception of the original author has been maintained and the work has been thoroughly revised and modernized by the addition of many new positions and new technique.

The placing of the three-age periods on one page is of special assistance, and the change of the middle period from fifteen to ten years is much more valuable.

A most welcome addition is the description of the developmental "normal" abnormalities under each appropriate radiogram, and these are of exceptional interest from an authority such as the present author.

The representation of chest radiography might, with advantage, be elaborated in any subsequent edition.

The paper and reproductions are of a very high standard, and the work is one of real usefulness. D. B. McG.

THE KENYA MEDICAL JOURNAL. Vol. i, No. 11, February, 1925. Published by the "East African Standard," Limited, Nairobi. Price 2s.

Probably in no colony has civilisation ever progressed, for better or worse, with such astonishing rapidity as in Kenya, and medical men, especially those in the service of missionary societies and the Colonial Office, have played no small part in laying the foundation of our culture in that country. We therefore welcome the appearance of the *Kenya Medical Journal*, which will now keep the medical world informed of the progress of medical science in Kenya, and make widely known the medical problems that are peculiar to the Colony and how they are being dealt with.

No. 11 of vol. i, issued in January this year, and now before us, contains an excellent paper by Sir Leonard Rogers on the prophylaxis and treatment of leprosy, with special reference to tropical Africa. Sir Leonard points out that the available data for the incidence of this disease in Africa show a much higher rate per mille than in India, and he estimates the number of lepers in Africa to be at least 500,000, and in Tanganyika territory alone a recent report gave an estimate of 11,480 cases or 2·8 per mille. The leprosy problem is, therefore, a serious one for Kenya Colony.

The Venerable Archdeacon W. E. Owen, a veteran pioneer of the country, contributes an article on the practice of inoculation with smallpox amongst the Kavirondo tribe which is of interest to the anthropologist as well as to the doctor.

Dr. Clearkin contributes a review on recent literature on undulant fever in man and contagious abortion in animals, diseases which intimately concern a country in part occupied by European stock farmers and native pastoral tribes.

Instructions for collecting blood-sucking flies and ectoparasites are also of peculiar interest to residents and travellers in a country where the parasite problem is continually making itself felt on one's person.

The *Kenya Medical Journal* will be read with special interest by all medical men who know the Colony, and we heartily wish our new contemporary the success that it deserves. A. E. H.

MEDICAL EDUCATION. A Comparative Study. By Abraham Flexner. New York: The Macmillan Co. 1925. Pp. viii and 334. 10s. 6d. net.

It is hardly to the credit of the profession that it should be indebted to a layman for this eminently readable comparative study of its educational methods. Such is the case, and Mr. Flexner appears to have spared no trouble in acquiring full information on the subject which he discusses. As an indefinite part of biology, medicine is being gradually subjected to physical and chemical methods. Several portions of the large area which it covers have really no distinct individuality. Thus, anatomy, physiology and pathology are the sciences of normal structure, normal function and abnormal structure and functioning respectively; but if we regard the three sciences from the functional point of view, the lines of demarcation disappear. As one goes deeper into the whole science of medicine the subdivisions of the subject become still more difficult to preserve as entities. Biochemistry, pharmacology, bacteriology, hygiene are all shifting and developing divisions in which teachers and workers poach on one another's preserves. The situation is no better and no more stable on the clinical side. Disease may be an entity, but the line to be drawn between the pre-clinical and the clinical sciences is essentially conventional, useful in research and perhaps more so in education. Surgery, obstetrics and pediatrics are not natural domains, divided by definite boundaries from internal medicine, and the student of metabolism or heart diseases or infectious processes cuts across all the orthodox clinical divisions into which it is customary to divide the study of medicine. Looked at in this way, it is obvious that medical education cannot be planned without full regard for the facts.

Mr. Flexner discusses the subject from this point of view, and rightly comes to the conclusion that there need and can be no such thing as uniform medical faculties, composed of the same chairs, occupying the same territory. The entire field must be covered by a broad conception of physiology and pathology, and, under existing conditions, there is in most countries less danger to be apprehended from chaos than from uniformity. In the space of a short review it is impracticable to traverse the whole ground covered by this book. The book itself must be read to be fully appreciated. Although medical education is the subject of the volume, the author makes it clear that it is futile to draw the line between medical education and medical research. In the German universities teaching and investigation have long been regarded as equal factors in the conception of higher education. In this country, in France and in America, the universities were until recently mainly concerned with teaching, research being regarded as an incidental or individual affair. All this is now changed or in process of change, owing to the acceptance of the principle that efficient and progressive training is procurable only where original scientific activity is in progress.

It is obvious that, dealing with such a question as education, the author

could not ignore the financial aspect. On this he has some interesting chapters, from which it is clear that the medical faculties of Germany and Austria have suffered disastrously because, being most highly developed and most liberally supported before the war, they suddenly found themselves forced to live from hand to mouth. Stability has now been restored, and the various universities are now budgeted by the State. The situation was different both in this country and in America, though both have felt the financial strain. It is interesting to note that the author is of opinion that, of European countries, Great Britain is alone relatively doing better by medical education now than in the years just prior to the war, when probably she was doing less for medical education than any other country in Western Europe. We are inclined to agree. The danger is a relapse. Even now, British expenditure in the cause of scientific research and teaching lags far behind that of the smaller continental countries and of America to day, just as it did and does lag behind the German or Austrian pre-war level. R. H. F.

PNEUMONIA: ITS PATHOLOGY, DIAGNOSIS, PROGNOSIS AND TREATMENT. By the late R. Murray Leslie, M.A., B.Sc., M.D. Edited and revised by J. Browning Alexander, M.D., M.R.C.P. London: William Heinemann (Medical Books), Ltd. 1924. Pp. xiv + 351. Price 12s. 6d.

This book was written by the late Dr. Murray Leslie, and had practically reached completion at the time of his death. It contains the experiences of a physician who was on the staff of a chest hospital for nearly thirty years, and has been edited by Dr. J. Browning Alexander. There are not many books devoted entirely to pneumonia, so its appearance will be welcomed by many who wish to possess an authoritative work that is based on the practical experiences of one who has treated a large number of cases during a long period of time.

Every aspect of the disease appears to have been dealt with. There are chapters on broncho-pneumonia, influenzal and post-operative pneumonia, and on pneumonia in children. Otherwise, the book does not touch upon any side issues, but sticks to the point and gives the reader an excellent treatise on our knowledge of this important disease at the present day. In military medicine one is not inclined to look upon pneumonia as a cause of high mortality, yet we find that the author considers it to have probably caused more deaths in the European war than any other disease.

The chapters on the principles and methods of treatment are the most interesting. In discussing the expectant method, the author states that it is not a "wait and see" but a "wait and foresee" attitude that the wise physician must adopt. "Intelligent watchfulness" should be his motto. The conspicuous fact is that he is dealing with a self-limiting disease of short duration; it is the degree of toxæmia, and not the extent of the lung lesion, that is the cause of anxiety in uncomplicated cases. With regard to the

value of alcohol, the author points out that results of pharmacological investigations must not always be taken as a safeguard for practical therapeutics, as the action of alcohol is quite different in febrile conditions from the effects which it produces in health. Also, it can be utilized as a source of energy, as it has the great advantage over all ordinary foodstuffs that it requires no digestion. Thus it is a valuable emergency food that has a definite place in rational therapeutics. He is inclined to give it early, on the principle that stimulants of any kind must be more useful if given before the work expected from them is too great, and from experience of cases in a base hospital in France he thinks that if given as a routine early, larger amounts are seldom called for as an emergency.

The book contains much valuable information, and the author is not dogmatic. The facts are placed before the reader in a well-reasoned form, and he is sometimes left to formulate his own opinions, and to decide for himself. It is a comprehensive treatise, and an excellent addition to the existing literature on pneumonia. M. B. H. R.

Reports and Analysis.

Digitalis Leaf (tabloid 1 gr.) prepared by Messrs. Burroughs Wellcome and Co., Snow Hill Buildings, E.C.1, has been tried in the case of an auricular fibrillation consequent on mitral stenosis, with very encouraging results. It is proposed to test it further.

It is stated that the leaves are prepared under standard conditions, and the final product is physiologically standardized.

The preparation is valuable from a military point of view, as being in tabloid form it is portable, easily stored, and retains its potency.

The estimation of the activity is described as : 1 tabloid 1 gr. equals 11 minims of tinctura digitalis.

It is recommended, as a general rule, that the compressed tabloid should be crushed before administration and given as a powder, in order to obtain the maximum results.

Correspondence.

THE SIR HARRY THOMPSON MEMORIAL FUND.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

Sir,—Knowing that there are many brother officers and friends of the late Major-General Sir Harry Thompson, K.C.M.G., C.B., D.S.O., who are desirous of contributing to some material tribute to his memory, I venture to ask your kindly aid in publishing this appeal for funds to this purpose.

The decision as to the most suitable form for the memorial to take should, it is considered, be left in the hands of the Harry Thompson

Memorial Committee who will be guided by the wishes of subscribers and the sum collected. Cheques should be sent to Messrs. Glyn, Mills and Co. (Holt's Branch), 3, Whitehall Place, S.W. 1, who have willingly accepted the treasuryship of the Fund; or the undersigned

Osborne House, Yours faithfully,
Isle of Wight, S. G. GUISE MOORES,
August 28, 1925. *House Governor.*

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above,* or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS." War Office, Whitehall, S.W.1.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription for the Journal and Corps News Supplement is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News Supplement is also issued separately from the Journal, and can be subscribed for at the rate of 4s. (four shillings) per annum, including postage. All subscriptions are payable in advance.

Subscriptions for the Corps News Supplement separate from the Journal cannot be accepted from Officers on the Active List unless they are also subscribing to the Journal.

Single copies can be obtained at the rate of 6d. per copy, excluding postage.

Cheques or Postal Orders for Subscriptions, etc., should be made payable to the "Hon. Manager, Journal R.A.M.C." and crossed "Holt & Co."

All communications should be addressed to THE HON. MANAGER, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," WAR OFFICE, WHITEHALL, S.W. 1.

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ASSISTED BY

LIEUTENANT-COLONEL A. E. HAMERTON, C.M.G., D.S.O., R.A.M.C.

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Royal Army Medical Corps.

Original Communications.

AERIAL TRANSPORT OF SERVICE CASUALTIES.

BY WING COMMANDER H. A. TREADGOLD.

Royal Air Force Medical Service.

The Air Ministry accepts no responsibility for the statements or the views given in this article.

PRIOR to the consideration of the present position of aerial transport of sick and wounded in the Royal Air Force and of the actual experience gained up to date, it is as well to give a brief résumé of the work done in this respect by other countries.

Here France stands out pre-eminently. Her experience of aerial ambulance work in her colonies appears to be considerably greater up to date than that of the rest of the world put together, and consequently some account of the methods employed, the types of machines used and the invaluable experience gained is essential as a prelude to this article.

The question of routine evacuation of sick and wounded by air was first taken up seriously by France in 1920, when a special type of Breguet machine was constructed, known as the "limousine" 14 T bis of 300 h.p., designed to carry two cot cases, a medical officer and an orderly or sitting case. The machine is a modification of the Breguet 14 T civilian passenger machine, which again is a development of the Breguet 14 A 2 and B 2, the standard reconnaissance and day bombing machine of the Army Air Service.

The cabin is situated in the fuselage between the engine and cockpit, and the stretchers are placed one above the other. The after portions of the sides of the cabin can be quickly removed and the stretchers introduced. The upper stretcher is put in first and swung into position by wires passing over a series of pulley wheels. The lower stretcher rests

on the floor. Electrically-heated warming bags are provided for both stretchers, as well as oxygen, the usual first-aid equipment, bed pans and urine bottles. The two latter are supported in holes in the floor of the cabin, through which they can be emptied while in the air. The average

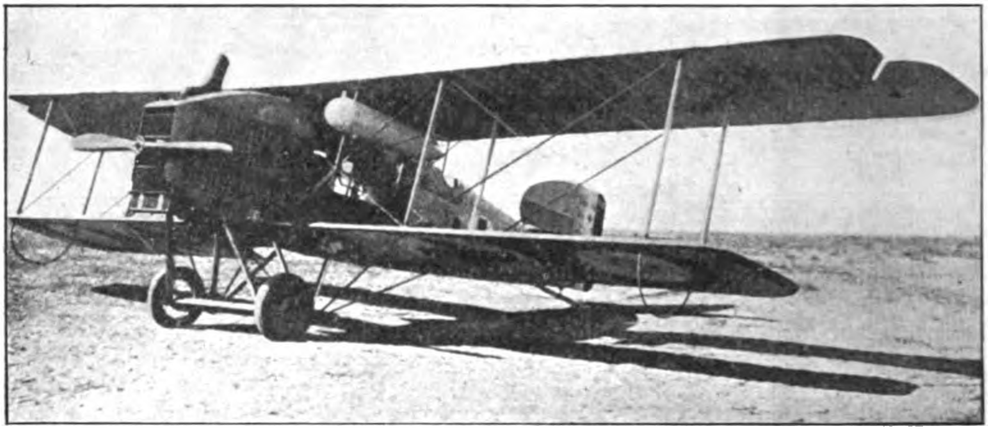


Fig. 1.—A general view of Breguet 14 T bis limousine ambulance. Accommodation : two stretcher cases and one sitting case.

Fig. 2.—Unloading a patient from the Breguet 14 T bis limousine.

touring speed is about 85 miles per hour. The length of the cabin is 6 feet 10 inches, width 3 feet 5 inches, and height 4 feet 9 inches. Petrol capacity four and a half hours. Illustrations Nos. 1 and 2 show the general appearance of the machine. Its performance in contrast with that of other ambulances is given in detail in the Appendix to this article.

An older type of ambulance, now largely superseded by this type, was a modified Breguet 14 A 2, in which the pilot is seated in front and two stretchers are placed in the fuselage behind. The main disadvantage is the comparative exposure and the very limited space in the absence of a limousine body, and the impossibility of carrying an attendant. It can, however, land in a more circumscribed area than the 14 T type, and consequently is still employed in certain areas in Morocco.

Criticizing the limousine 14 T bis without any personal knowledge of the machine, its drawbacks appear to be its limited capacity, lack of head room, absence of wireless, and the method of disposal of dejecta (which, especially in tropical countries, might prove a serious source of infection). Its essential advantage is that it is a modification of the existing type, and consequently can be produced in large numbers without delay.

The only other type in existence is represented by two seaplanes modified for use as ambulances at two French naval air stations.

The figures of sick and wounded carried by air from 1921 to 1923 are striking. In 1920, eighty sick and wounded were evacuated from the besieged fort of Ainlab in Cilicia in the fighting aircraft from which the machine-guns had been removed. In 1921, 150 wounded from the columns operating in the Euphrates were brought to Aleppo (250 kilometres) in two hours. In October of the same year, in Morocco, eighteen seriously wounded cases were evacuated in six machines and covered eighty kilometres in thirty-five minutes, a journey which would have taken over three days in the ordinary way. These figures are trifling when compared with those of 1922 and 1923, when the Breguet ambulance commenced to function.

In 1922, 1,200 wounded were evacuated by air in Morocco and the Levant. In 1923 a record in this type of work was created in Morocco when, from May onwards, nearly 1,000 wounded were evacuated from the middle Atlas region, a particularly isolated region where the French troops experienced severe fighting and heavy losses. This was rendered possible by the troops clearing a chosen site immediately on their arrival at fresh camp sites, with the result that there is now a network of landing grounds from the Atlas region to the sea.

The squadrons were distributed at about a dozen headquarters, each accommodating eight to fifteen fighting aircraft and one, two or three ambulance machines. These could be quickly assembled at some central place, and thus seventy-two wounded were evacuated on the evening of September 3, 1923, and fifty-one on the following day. As a rule the same pilots who had been bombing, reconnoitring and taking photos all day, had to evacuate the wounded in the evening.

The wounded were taken to the landing ground by mule-litter or by Kegresse-Citroën car and flown to the Base Hospital at Fez Maknes, Rabat, or to Casablanca, in one or two stages, the distances varying from eighty to 160 kilometres. It was considered that at least one-third of the wounded would not have survived any other form of transport.

The whole of these evacuations were performed without a single serious accident.

As a consequence of these excellent results each squadron in Morocco now has two ambulance machines in addition to their fighting aircraft. These ambulances are entirely at the disposal of the local medical service, which applies direct to the C.O. of the squadron when a machine is required urgently. It is his duty to keep at least one aerial ambulance permanently in flying condition, ready to start within half an hour from the time the order is given to the squadron.

For further details the reader is referred to a most interesting article on "L'Aviation Sanitaire au Maroc," by Lieutenant-Colonel Cheutin, commanding the Air Service in Morocco, and published in *L'Aviation Sanitaire* in November, 1923. I cannot refrain from extracting certain portions of his article here, as they represent a valuable summary of important points based on practical experience. It should be remembered that there is no separate Air Service in France and consequently no separate Air Medical Service :—

"1. *Efficiency.*—After four years' experience in the employment of Medical Aviation in Morocco, I am convinced that the efficiency of a Medical Air Unit depends in particular upon the four following points :—

"(1) Close and cordial co-operation between the Air Service and the Army Medical Service, keeping in mind the object to be attained and the necessity for the maintenance of close liaison, in order to overcome the difficulties which inevitably arise in a new Service.

"I am glad to state here that this system of co-operation has been maintained throughout in Morocco, and I take the present opportunity of paying a well-deserved tribute to the personnel of the Army Medical Service in Morocco, whose devotion has won general appreciation during recent operations.

"(2) Complete confidence and faith on the part of doctors and airmen alike in the future of Army Medical aviation.

"(3) The existence of a large number of landing grounds, suitably distributed all over the country; these grounds may also serve for fighting aeroplanes, as well as for commercial or medical machines. Their construction is therefore a matter of primary importance and, in my opinion, which I cannot emphasize too frequently, this should be our first care, since the development of aviation and consequently its efficiency are closely connected with this important question of the previous organization of landing grounds.

"(4) The choice of practical and comfortable aircraft with a good range of speed and maximum degree of safety, easily piloted without undue fatigue and capable of landing anywhere, even on difficult ground.

"In the Colonies medical aeroplanes should resemble as closely as possible the normal type of machine in use in squadrons; this serves a double purpose, in that it allows of trained pilots being always available and also facilitates the upkeep and repair of material.

"These reasons do not in any way exclude the possibility of considering the introduction of aeroplanes specially constructed for the transport of heavy loads. These will have their use in the Colonies both as bombers and for the transport of troops and wounded, and may also be used for civil purposes.

"2. *Pilots.*—As regards pilots, it is logical to pick only the best for the medical aeroplanes. This principle, which has been applied in Morocco for four years, has produced excellent results.

"I must admit that, at the outset, I encountered a certain degree of scepticism on the part of some aviators who were too absorbed in actual fighting to appreciate the importance of their new mission. I have, however, endeavoured to instil into my aviators the idea that, in Morocco, the work of transporting the wounded takes priority of bombing and reconnaissance, since it is concerned with the endeavour to save the lives of fellow-soldiers who have suffered in the discharge of duty. I have, moreover, been strongly supported by the Higher Command, which, in the distribution of awards, has never hesitated to place on an equal footing photographers, bombers and pilots of medical aeroplanes.

"During 1923 the 37th Air Regiment has transported without accident nearly 900 serious cases of wounded or sick, 175 of these during July and 199 during August, the distances varying from thirty to 300 miles. I would mention, in particular, the transport of sick civilian officials from remote districts, the evacuation by night of two men severely wounded and requiring an immediate operation, and the case of an officer's wife who was seriously ill and was taken by medical aeroplane from the station at Tadia to the hospital at Casablanca, a distance of nearly 200 miles.

"3. *Conclusions.*—Experience in the Levant and Morocco affords indisputable proof of the value of the medical aeroplane, which is neither more dangerous nor expensive than other modern methods of transport for the sick and wounded.

"It has the further advantage of enabling the Command to evacuate the wounded rapidly to the rear, thus relieving the transport columns and economizing in the protection of these columns. Further, from the technical point of view, it gives a greater degree of mobility to the columns during operations, by freeing them from the necessity of providing for the transport of wounded and sick.

"Lastly, it produces a considerable moral effect on the natives, for whom it is also available; it contributes to the saving of valuable lives, and to the reduction of human suffering to hitherto unknown extent.

"In conclusion, I consider that this problem is solved, and that, as regards the Colonies, of which I can speak with practical experience, medical aviation should, without delay, be employed as generally as possible, and should become the normal mode of transport for the wounded."

These points will be discussed later in the article in the light of Royal Air Force experience.

In America, until the last few months, no special aerial ambulances have been built, reliance being mainly placed on standard two-seater machines, such as the D.H. 4 B., modified to take one or two stretchers in the existing fuselage. The essential duties of these machines were for emergency crash work. Quite recently two new machines have been constructed, specially designed as aerial ambulances, having accommodation for two stretcher cases and a surgeon or orderly. The performance is quoted as being 116 miles per hour, with a landing of forty miles per hour and a petrol capacity of three hours. The ambulance compartment has sixty-five inches head room, is well ventilated and has windows on both sides of the roof. The stretchers are inserted through an opening in the side of the fuselage, and fixed in position by shock absorber snap hooks. As

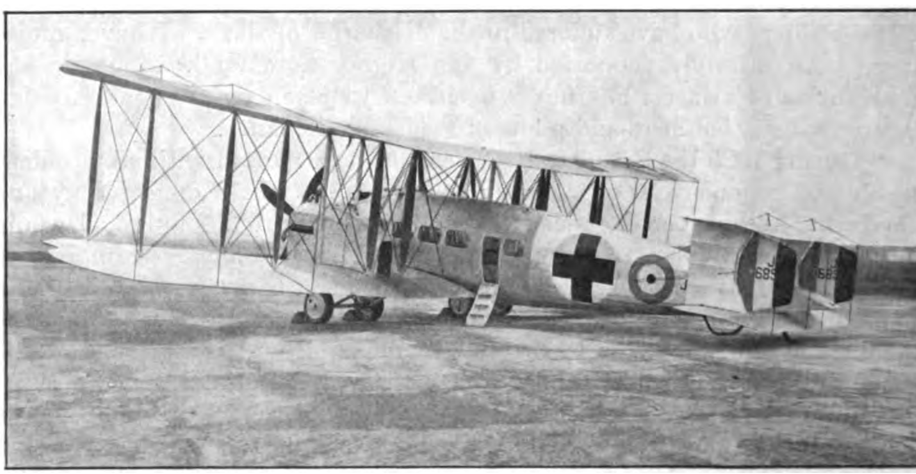


FIG. 3.—The original Vickers-Vernon ambulance at Weybridge.

far as I am aware, no evacuation of casualties by air on a big scale has ever occurred in the United States.

Other countries appear to have had no experience in aerial ambulance work apart from the occasional conveyance of an invalid by an ordinary aeroplane, and I have not heard of the existence of any Service aerial ambulances, other than those already specified, and those of the Royal Air Force.

The first aerial ambulance built for the Royal Air Force was a Vickers-Vernon twin-engined machine constructed at Weybridge in 1920. (See Illustrations, Nos. 3 to 5, and for accommodation see Appendix.) Stretchers were passed into the body of the ambulance through a hole in the nose of the machine, normally covered by a square detachable door. The stretcher legs ran along grooves for a distance of three to four feet along a tunnel in the machine which opened out into the body. The two pilots were situated

side by side above the tunnel in the forepart of the fuselage. Collapsible stretcher racks in two tiers along one side of the machine took four stretchers. The crew consisted of the two pilots, a fitter, a wireless operator mechanic, and a medical officer or orderly, the three latter being accommodated in the body of the machine. Each stretcher case had a separate regulated supply of oxygen. A wash-basin, electric kettle, electrically heated body-warmers, and cupboard space for an ample supply of drugs

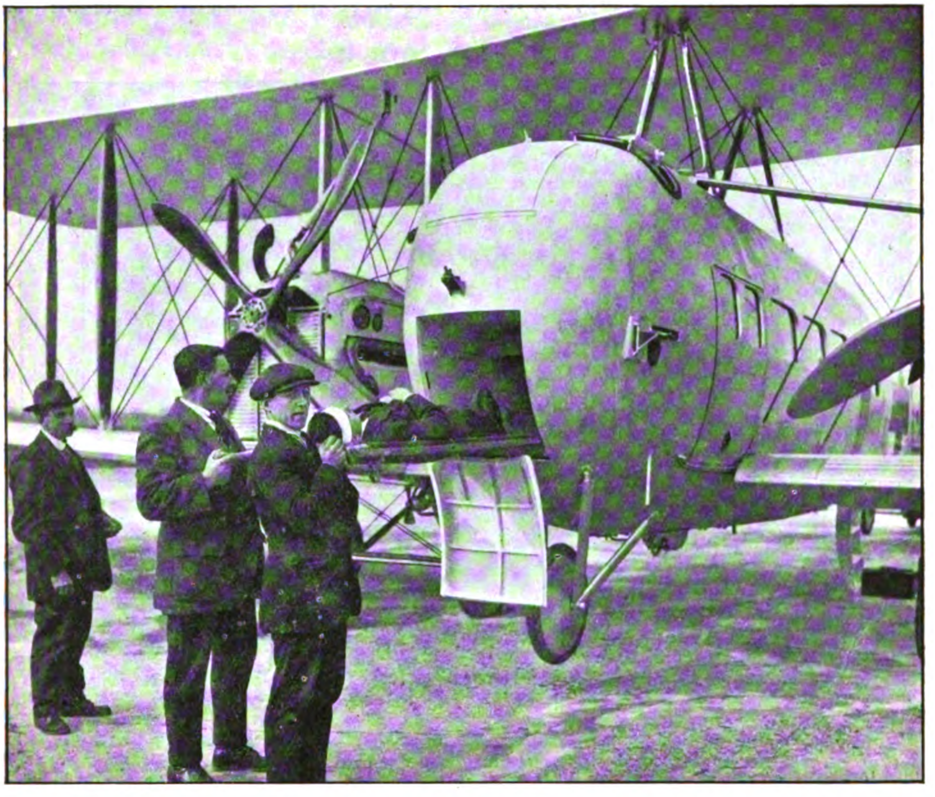


FIG. 4.—The same machine as in fig. 3. Showing method of loading through the nose.

and dressings were also included. A screened off water-closet in the rear portion of the body was fitted with a tank to collect all dejecta—an important point, especially in the tropics, when dealing with such cases as dysentery. Electric light was provided and a small fan fitted for ventilation purposes in the forward bulkhead. Additional adjustable ventilators were fitted on either side of the body aft. A separate water tank with a capacity of forty gallons for drinking purposes was also placed aft. Adjustable triplex glass windows were fitted along two-thirds of each side of the hull.

After a considerable period spent in alterations and adjustments, the machine was finally re-erected at Aboukir in 1922 and completely "written off" in a bad crash shortly afterwards without even carrying a single patient. In the meantime two fresh machines were being built on similar but improved lines. (See Illustration No. 6 and Appendix for details of accommodation.) The main differences were :—

(1) Oxygen apparatus was simplified and wash-basin eliminated.

(2) The lower two stretcher racks were omitted and ten folding collapsible deck chairs introduced, six under the stretcher racks and four on the

Fig. 5.—The same machine. Interior, looking aft. Rear stretchers are in position. Front stretcher racks and stretchers are folded up in the left foreground.

other side. These proved extremely comfortable in practice, and the fact that a patient assumed a position of semi-recumbency in them made them entirely suitable for many patients who would have otherwise been stretcher cases.

(3) The fan fitted was found useless in practice, and the two forward windows were hinged at the back and made to swing out, so as to catch the slip-stream of the propellers on either side for ventilation purposes. This was an important point, as the temperature inside the hull, when the machine was at rest under the full blaze of the Iraq summer sun, rose to danger point, although the hull itself had a double lining with a two-inch air space.

(4) Gauze windows were substituted for triplex glass to lessen weight. These were a complete failure, as they made the hull extremely draughty and cold.

These machines were despatched to Aboukir early in 1922, and after re-assembling the first one crashed on its way to Baghdad, in the Judæan hills, at the end of 1922. The damage was not sufficiently serious to cause a "write off," and it was repaired at Aboukir. In the meantime the second machine was flown successfully to Baghdad early in 1923. After a trial trip to Mosul and back early in March (440 miles) without incident, it collected four or five sick from Kirkuk (180 miles

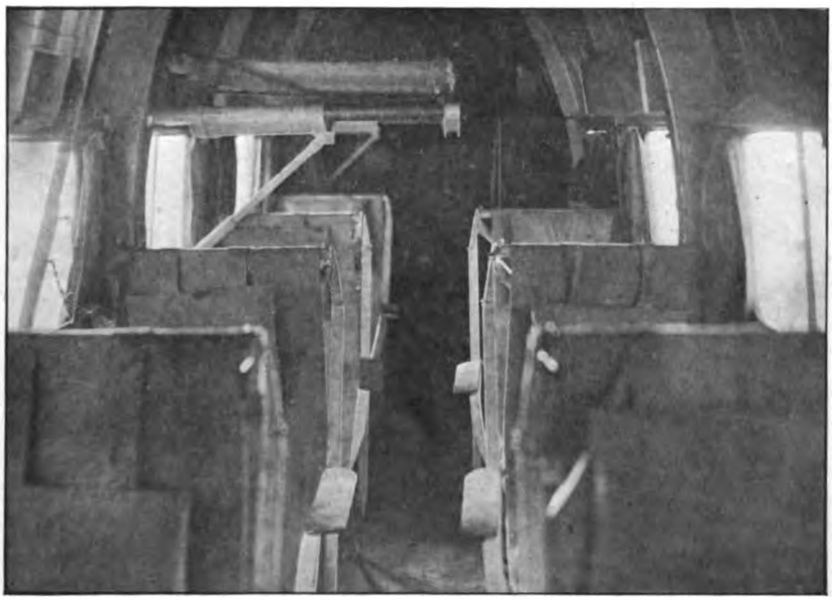


Fig. 6.—Showing interior view, looking aft, of second type of Vickers-Vernon Ambulance. One stretcher and all seats are in position.

from Baghdad) the following week. Everyone agreed as to its extreme comfort, but condemned the gauze windows as too draughty. The evacuation of sick from the column in Kurdistan started shortly afterwards, and it appeared that at last the experience wanted was to be obtained, but unfortunately the machine, in landing to collect its first load of sick, ran into a ditch and was completely "written off." The remaining machine, repaired at Aboukir, arrived in Iraq, after flying across the desert, in September, 1924. It was brought into use immediately for routine weekly evacuation of sick from Kirkuk to Baghdad. By this time fresh machines of the same type were rapidly nearing completion at Aboukir, and the evacuation of invalids for the United Kingdom by a Vernon ambulance, accompanying the fortnightly air mail when necessary, was rapidly becoming a practical probability.

In building these machines the possibility of their use for evacuation of patients from Iraq to Egypt by the cross-desert route was especially kept in mind. The distance is just under the 1,000 miles, and has been completed from sunrise to sunset, but in practice the air-mail machines take two days, the halting place being Ziza, on the edge of the desert in Transjordania, thirty miles north-east of the northern shore of the Dead Sea. Ziza is about 100 miles nearer Cairo than Baghdad. The main difficulty is the large petrol capacity required for heavy machines in crossing the desert, which curtails the load considerably, and the maximum number of sick capable of being carried by Vernon ambulance on this trip is four, although accommodation is available for ten. This route

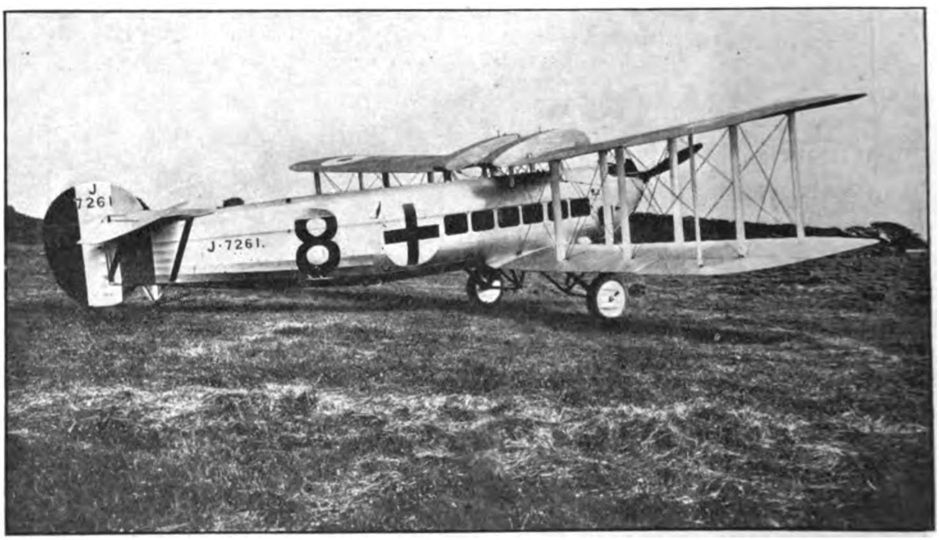


FIG. 7.—" Avro " Andover Ambulance. Stretcher cases are loaded through the side door covered by the Red Cross on the fuselage.

offers the particular advantage of speed in evacuating sick from Iraq, as the time taken to Cairo is two days, as opposed to three to four weeks when going by ship via Basra and Bombay. It is especially useful in the summer months, when the sea-trip is not only rough, owing to the monsoon, but dangerously hot in the Persian Gulf. Cases arriving at Bombay at this time of the year are sometimes delayed from two to three months in hospital in India until troopship accommodation becomes available. The danger of forced landings to patients is minimized by the ambulance accompanying the air mail. An actual crash involving injury to the occupants is rare. I do not remember a single case of injury on the air route in the last two years.

A new type of single-engined machine, the Avro-Andover ambulance, was designed in 1923, and three are now in commission in England (see

Illustrations Nos. 7 and 8). It has accommodation for two stretcher and two sitting cases, or four sitting cases in canvas folding chairs similar to those already described. It is superior to the Vernon type in several ways.

(1) It has greater head-room, approximately six feet.

(2) Ventilation is by exhaust fan in rear of fuselage; a regulated supply of hot air is taken in from the outside of the exhaust pipe.

(3) Ample lockers for kit are fitted.

(4) It has petrol capacity for seven hours' flight on full load.

The engine is a 650 Rolls Condor with self-starting motor. The crew consists of a pilot, wireless operator and medical attendant. Details of its general performance will be found in the Appendix.

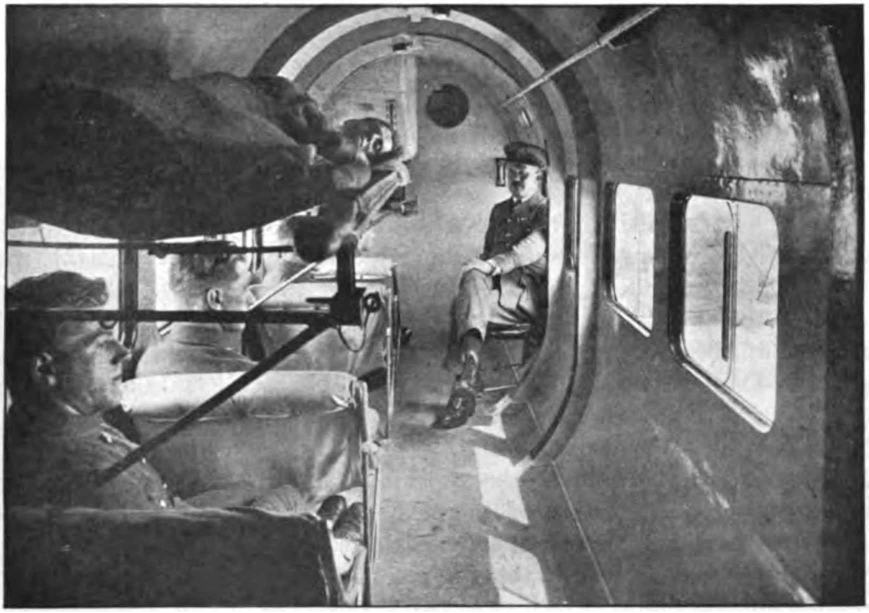


Fig. 8.—"Avro" Andover Ambulance. Interior of cabin looking forward, showing folding chairs and one stretcher in position.

This machine is particularly suitable for the air route, as its accommodation is sufficient, if run regularly, to cope with the average number of invalids from Iraq, and it is much cheaper as regards upkeep and running costs. It is also suitable for emergency crash work and routine evacuation of sick from outlying stations, on which work it is at present being tried in England, but is on the small side for large scale evacuation. Its drawback is that it is not a stereotyped Service type. The importance of this point is discussed later in the paper.

From what has been said it will be seen that no appreciable information is available as to how the general interior fittings stand up to prolonged

use, as the first two Vernon ambulances crashed before they were brought seriously into use, and the remaining one only started functioning in Iraq last autumn, but an outbreak of sickness occurring in a column in Kurdistan, in the spring of 1923, provided an admirable opportunity of finding out how practicable it was to use standard R.A.F. machines for evacuation of sick over considerable distances on a large scale.

Before discussing the actual experience gained in the R.A.F. in the aerial transport of sick and wounded, which has been obtained almost entirely in Iraq in the absence of any aerial ambulances, owing to the various accidents specified above, it would be as well to examine what means of transporting sick by air were available, prior to the first big evacuation from the Kurdistan column in the spring of 1923.

Four types of machines were in the country :—

(1) One single-seater fighter squadron, useless for sick, owing to their being single-seaters.

(2) Five squadrons of two-seater machines, D.H. 9 A's and Bristol fighters (mainly the former).

(3) Two squadrons of large twin-engined Vickers-Vernon troop carriers.

As regards (2), although a two-seater machine can always take a sitting case in the back seat, there is the danger of collapse of the patient, which may result in his falling forward and jamming the controls. Consequently a special stretcher (the naval pattern known as the Neill Robertson) had been modified for fitting on the fuselage of either D.H. 9 A's or Bristol fighters. One or more of these were available at all stations in Iraq and Egypt at this time, and a detailed description of the apparatus is not out of place at the present juncture. In practice it has proved its worth as safe, practical and capable of being rapidly fitted. Its main drawback is the rather exposed position of the patient, and a consequent tendency to cold, but this is more apparent than real, owing to the thick nature of the hooded covering. Hot-water bottles can also be packed in without fear of shifting during flight. For emergency crash work, in the absence of Vickers-Vernon machines, it is invaluable, owing essentially to the fact that it can immediately be fitted to D.H. 9 A.'s and Bristol fighters without any adjustment being required.

The apparatus consists of:—

(*a*) A Neill Robertson stretcher, as used in the Royal Navy for transhipping helpless patients. The stretcher is constructed from green Willesden canvas, strengthened on the outside with contiguous bamboo battens. Webbing straps and metal buckles are attached to the canvas, so that the patient can be completely and securely encased when placed in the stretcher. Rope slings are attached to the bamboo rods for lowering the apparatus from ships. These ropes have been retained as they provide a ready means of attaching the stretcher to the fuselage. In addition, a head pillow has been strapped to the interior surface of the stretcher.

(*b*) A one-piece cover, similar to a monk's habit (cloak and cowl), consisting of Willesden green canvas, lined within with blanketing and provided with stud buttons to take a second lining if such is required. The complete covering encloses the stretcher when the patient has been placed within the latter. A lined flap extends from the back of the lower border of the cloak to enable it to be brought forward and fixed anteriorly, in order to protect the feet.

A face mask of canvas detachable from the cloak is also provided.

The weight of stretcher is 18½ pounds, and that of cloak and attachments complete 21 pounds, making a total weight of 39½ pounds.

The method of attachment is as follows :—

(*a*) Each of the six grommet loops of the stretcher is supplied with one-inch leather straps, the upper four of fourteen inches length and the lower pair of thirty-six inches length.

(*b*) A canvas foot strap, four inches in width, encircles the fuselage and is connected to the foot ring of the stretcher by a thirty-six-inch strap, the object being to prevent lateral movement of the apparatus during flight. Each strap is clearly stamped to indicate the attachment.

The method of fitting can be easily understood by referring to Illustrations Nos. 10 and 11.

Turning to the third variety of machine available, viz., the Vickers-Vernon, these machines are identical as regards main structure and body space with the Vernon ambulances. The seating capacity in the hull is, however, confined to a long, uncomfortable wooden bench running the length of one side of the hull, subdivided internally into lockers. Passengers usually sit on the floor, or on stray pieces of kit, in preference to the acute discomfort of sitting on the narrow seat with half a gale blowing on their shoulders, neck and face through the gauze windows. No water-closet is fitted. These machines, dependent on the type of engine fitted, can carry from eight to twelve passengers on limited flights up to say 240 miles. Above this the extra amount of petrol carried lowers the passenger capacity accordingly.

A later type of troop carrier is the Vernon-Victoria, very similar to the Vickers-Vernon, but larger and capable of carrying twenty-four passengers. Its general discomfort is on a par with its predecessors, but as a result of representations from Iraq all fresh troop carriers are now being fitted as standard with two stretcher racks and folding deck chair seats for twelve (see Illustration No. 9). There is consequently excellent accommodation for fourteen casualties, apart from extra floor space which would take two extra stretchers if required.

This machine makes an admirable aerial ambulance for evacuation of sick on a large scale, and has the advantage that it is a standard type available in numbers at once if required for medical work.

Thus it will be seen that though no actual aerial ambulances were available in Iraq in the spring of 1923, casualties could be carried in a

certain amount of discomfort in large numbers at short notice. This leads us to a consideration of the evacuation of sick from the Kurdistan column in Iraq in April, 1923, when some 200 cases of diarrhœa and dysentery occurred amongst a column of British troops operating in Northern Kurdistan. The units concerned were on the return march from Rowanduz, and the only available transport consisted of pack animals, as the mountainous nature of the country precluded the possibility of wheeled transport. In the circumstances, Vickers-Vernon aeroplanes were used to deal with the situation, and were despatched from Baghdad to Kirkuk on April 28. The evacuation of cases was commenced from a point near

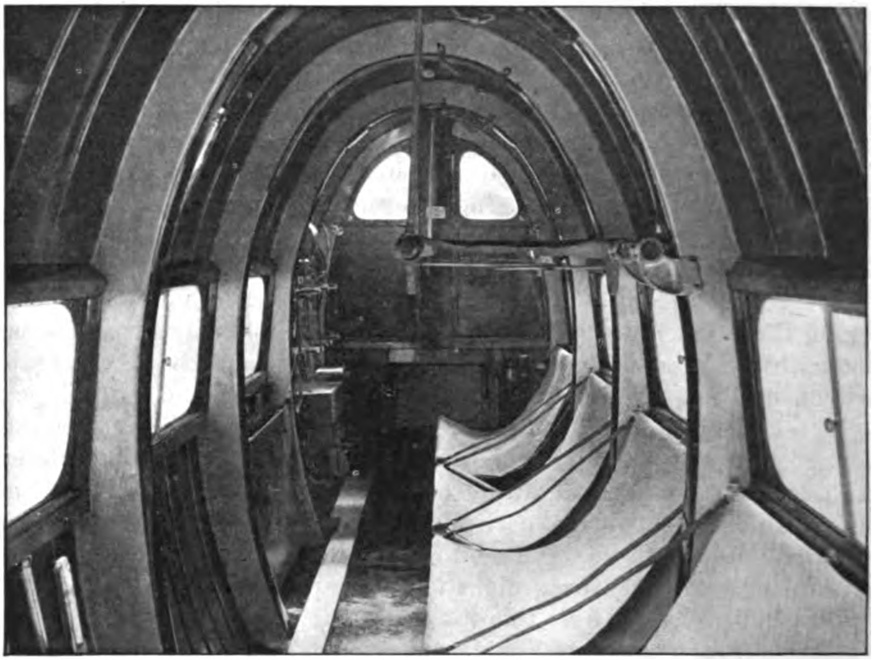


Fig. 9.—Interior of Vickers-Vernon Troop Carrier and Ambulance, looking forward. The forward stretcher only is in position.

Serkhuma. The selection of suitable or even possible landing grounds in this area was a matter of very considerable difficulty, and pilots had to exercise more than ordinary skill, being further handicapped by altogether unusual atmospheric conditions. The operation was successfully concluded on May 2. The first two days were characterized by extremely bad weather, particularly bad for the type of aeroplane in use. The aeroplanes were compelled to climb to at least 5,000 feet, so that control could be retained in the crossing of the Adghir Dagh Mountain ridge. Before the effects of the strong air currents over this ridge were recognized, a Vickers-Vernon loaded with sick, with both engines running normally, was forced

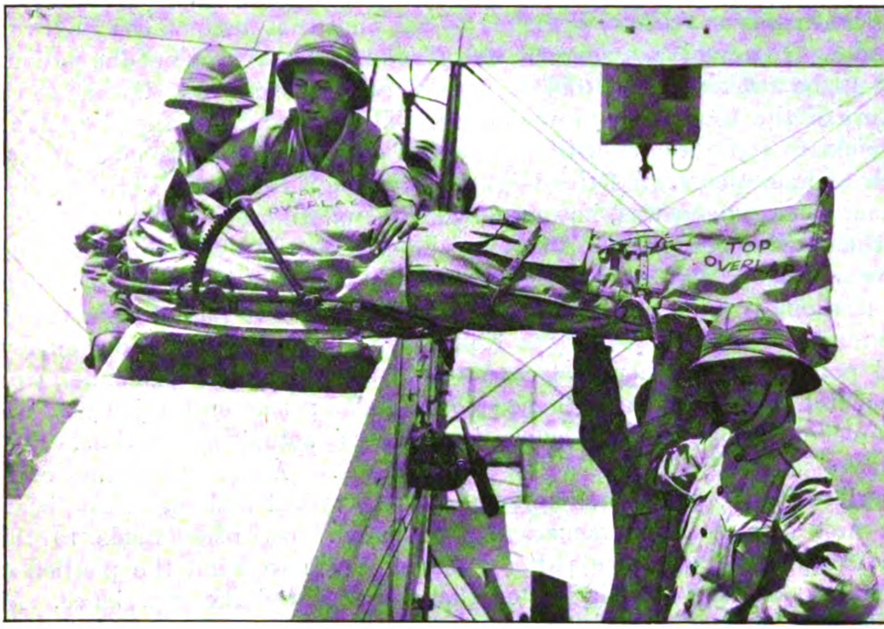


FIG. 10.—Showing method of loading Neilson stretcher and its attachment to the gun ring of the fuselage.

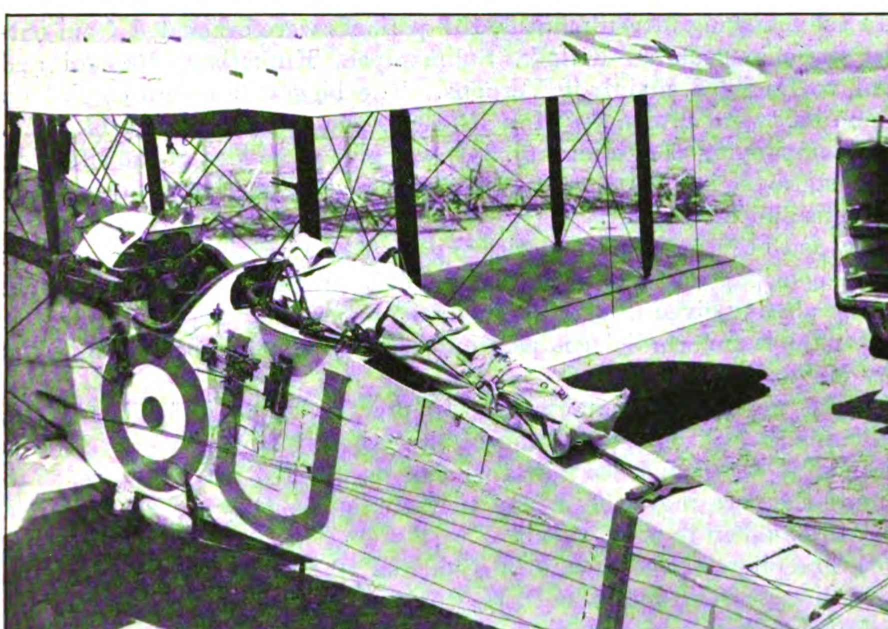


FIG. 11.—Neilson stretcher secured to the fuselage.

down from 3,000 feet and crashed in inaccessible country. This unavoidable crash was so skilfully managed by the pilot that none of the sick were injured. In actual fact, after the aeroplane had crashed, one of the patients had to be awakened and told to get out of the aeroplane. Owing to the nature of the terrain, there was no possibility of landing other aeroplanes to pick up the patients without running serious risk of damage to both crew and aeroplane. A Bristol fighter, carrying a Royal Air Force medical officer as passenger, was, however, by skilful piloting enabled to land close to the crashed aeroplane. A seriously ill patient, who probably would not have survived, was at once evacuated in the second aeroplane. The medical officer remained with the sick and was able to render assistance in the long and difficult journey to Koi, which was accomplished on donkeys and ponies. Altogether, 198 cases, exclusive of medical personnel, were evacuated to Kirkuk and thence to Baghdad; the entire journey was completed by air in 128 hours 45 minutes' actual flying time. The mileage covered amounted to 9,615 miles. Apart from the crash described above, the Vernon ambulance was crashed without sick on board the first day of the evacuation. Reference has been made to this previously. None of the patients carried seem to mind the method of transport, and the majority stated that they enjoyed the experience. All stood the journey well. Serious cases were evacuated from Kirkuk to Baghdad in the early morning or late afternoon in order to lessen the possibility of air sickness, which is apt to occur during the hot period of the day when "bumps" in the air are experienced.

In the following fifteen months, 161 patients were evacuated from outlying stations, such as Kirkuk, Sulimaniyeh, Kinkerban, Ramadi and Mosul, to Baghdad, mainly in Vernons. The biggest numbers carried on any one day were fifteen on May 18, 1923, and ten on August 14, 1923. The accompanying sketch plan (p. 337) will give some idea of the situation of the stations in Iraq and the distances covered, both during the operations and afterwards.

Now as to the practical experience gained as a result. It would be as well to consider this under the same heads as those raised by Colonel Cheutin, already given in detail early in the paper:—

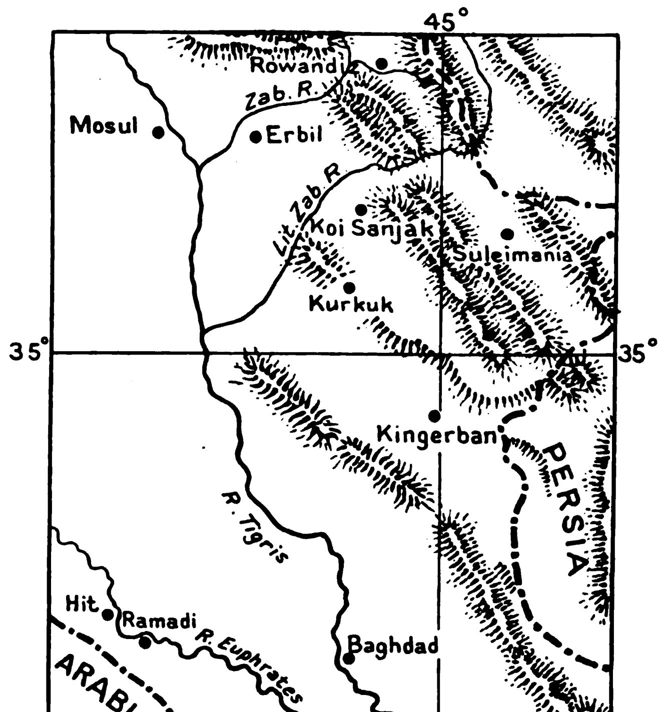
(1) "Close and cordial co-operation between the Air Service and the Army Medical Service."

This is of supreme importance. In practice minor difficulties arose, mainly due to lack of appreciation of the other's point of view. Let us take these in detail and see how they can be avoided in the future, as to my mind they are inevitably bound to recur unless they are realized and steps can be taken to avoid them.

(*a*) The pilots of the machines could not understand why they should be told that a certain number of sick would be ready at say 16.00 hours at a certain landing ground, and find, when they arrived, that they might possibly have to wait from one to two hours, and that a number of

additional patients might turn up at the last minute. They naturally could not appreciate the necessity for the completion of the field cards for every patient, when every minute was of vital importance if the patients were to be evacuated in daylight that day.

(*b*) R.A.M.C. officers found it difficult to realize the strain involved in flying heavy machines under the particularly trying weather conditions prevalent. They were inevitably ignorant of the essential points of an aerodrome, and if, after a long day's march in the rain, no machines were waiting to carry off their sick, they could not be expected to appreciate



Scale :- 50 miles = 1 inch

off-hand the fact that light machines could land in a circumscribed area where the heavy Vernons could not get down, and if they did, would probably crash in doing so, owing to their wheels sinking into the soft ground.

(*c*) The sick seldom arrived at the machines at the scheduled times, thus causing prolonged hold-ups. The main causes of this were :—

(i) News would be received that the column would arrive at a certain spot at say 14.00 hours. In a difficult mountainous country, where the column frequently had to proceed in single file, there would be a difference of from half to two hours between the times of arrival of the advance and

rear guard, and the sick and field ambulance would be practically the last to arrive in camp.

(ii) Further wireless messages during the day revising arrival times might fail to reach the pilots in time.

(iii) "Atmospherics" were particularly bad at intervals during the evacuation, thereby delaying receipt of messages.

(iv) The distance from the camp to the only available landing was in two cases practically a mile. This meant a delay of at least twenty to thirty minutes, and in one case a convoy of patients lost their way as the landing ground was in a dip in the ground, and they took forty-five minutes for the journey.

(v) The necessity for the examination by the medical officers, on arrival in camp, of fresh cases falling sick during the day, to determine whether they were sufficiently urgent to require immediate evacuation.

(vi) The need of food of some sort for patients who arrived in camp in a state of collapse after a long day's travelling on a donkey (the only means of transport).

How can these difficulties be eliminated in future? Let us take them seriatim.

First and foremost, some liaison is necessary to explain to pilots such points as difficulty of accurately forecasting daily numbers of sick to be evacuated during an epidemic, the position of the sick at the end of a marching column except in case of a retreat, and the essential need for case cards. On the other hand, R.A.M.C. officers should be informed beforehand of such points as the difficulty of landing heavy machines on soft ground in restricted areas. This was not done in the case under review, as unfortunately the R.A.F. medical officer in charge of the evacuation proceeded to the crashed machine with sick on board the first day and could not get in touch again until the last twenty-four hours of the evacuation.

The presence of such an officer is essential, as he should be in the special position of being able to appreciate the points of view of both sides, and by explaining matters beforehand, or at any rate, at the first possible moment, do much to ensure the smooth running of affairs.

The R.A.F. liaison officer with such a column cannot appreciate the medical point of view, but at the same time could do much by explaining the limitations of aircraft to those in medical charge of the column, but the essential pivot on which such an evacuation should work, could, in my opinion, only be a R.A.F. medical officer of sufficient experience to be able to foresee probable difficulties and meet them in advance. He would require a light two-seater machine and pilot to be at his entire disposal and have a free hand as to his own movements. The point at which the R.A.F.M.S. take over responsibility of casualties from the R.A.M.C. in a combined operation can only be when the sick are loaded in machines on the landing grounds. The responsibility for any medical attention required en route, through crashes or otherwise, must fall on the R.A.F.M.S.

Delays in arrival of sick at the machines can be met in various ways.

(a) Cases found at the morning sick parade to be requiring evacuation the same day should be sent forward under a medical officer as near to the head of the column as possible, with orders to superintend personally their evacuation at the first available moment after arrival. Cases falling sick en route should be held back, if possible, for dawn evacuation the next day.

(b) Wireless messages dealing with numbers of sick should specify time of arrival at camp with reference to their exact position in the column.

(c) Selection of Camps in Relation to Landing Grounds.—An allowance must be made for the time taken to convey sick from their camp to the landing ground, and this presupposes a knowledge of the exact position of both in advance. Wherever possible these should be side by side, otherwise delays become inevitable. When, as in the present case, there is too much danger in night air evacuation from practically unknown landing grounds over country where engine failure means a crash, a fight against time can always be expected towards the end of the day when machines have a long flight in front of them after sick are on board.

(2) "The existence of a large number of landing grounds suitably distributed all over the country."

The routine practice adopted by the French in Morocco of clearing suitable landing ground immediately on arrival at camp when on the march in hostile country appears to be an admirable one.

Aerial evacuation of sick is necessarily dependent on the existence of landing grounds, but much can be done by ground troops in this connection. The selection of suitable sites fall, of course, on the R.A.F. liaison officer with the ground forces.

(3) "The choice of comfortable aircraft resembling as closely as possible the normal type of machine in general use."

This is a very sound point and has already been adopted by the French (*v.s*). Special machines of a non-Service type, possibly with special engine, require fitters, riggers and pilots acquainted with them, and there are further difficulties, such as minor repairs in distant aerodromes where the personnel may be unacquainted with the type. It also involves the allocation of special personnel to such machines which in practice would probably have to be found from the existing strength of the squadron or squadrons to which they were attached. This would render such machines unpopular from the start and detract from their efficiency.

The question of comfort was met in the French evacuation by the use of their special aerial ambulances. In Kurdistan the floor and seats of the uncomfortable Vernons were padded with grass and straw to minimize this, but there is no gainsaying the fact that even then there was very little actual comfort in them.

(4) "*Pilots.*—It is logical to pick only the best for medical aeroplanes, as has been done in Morocco for four years with excellent results."

A further good point, but not so easy in practice, if special aerial ambulances are attached as supernumerary to fighting squadrons. The French have solved the question by having two such machines forming a definite part of each of ten squadrons in Morocco, but with the inevitable drawback of diminishing the number of their fighting aircraft in the process. In my experience pilots do not like sick evacuation. The responsibilities involved in possible forced landings without a medical officer, who cannot always be available to accompany the patients, weigh seriously with them, and there is the further factor of being out of the fun in any action that may be going on at the same time.

This brings us to the point that aerial transport of sick may be provided for in three ways:—

(1) By attaching one or more aerial ambulances to squadrons for this special duty. This I consider is foredoomed to failure unless (*a*) special establishment is provided for them; (*b*) personnel are specially selected for permanent duties on them; (*c*) the type is similar to that in use in the squadron. (*a*) and (*b*) both involve considerable increased cost, and the arrangement generally would interfere with the homogeneity of the squadron. Given the hypothesis (*c*), the best arrangement would be that they take the place of one or more fighting machines in the squadron. Such an arrangement appears eminently suitable for two-seater squadrons, who could look after their own casualties in this way. Scout squadrons would have to be dependent on other squadrons.

(2) By establishing a separate flight, squadron, or wing, solely comprised of aerial ambulances. The main objection to this is that normally it would be largely unemployed, at least more so than the average fighting squadron, and I feel extremely doubtful if the best type of pilot would ever be content with such a job, as it would keep him out of the actual fighting. The squadron would also be largely under the control of the competent R.A.F. medical authority for all questions of movement, and dual control of this nature is not likely always to work smoothly in practice. For these reasons I am not in favour of this idea under normal conditions. It may, however, become inevitable in a future war, where aerial evacuation on a large scale becomes necessary for special reasons. In this connection it must be remembered that modern air warfare may materially affect such points as the number of ground troops required on lines of communication, and aerial evacuation of all casualties would be an important factor.

(3) By carrying on in the same way as in the Kurdistan evacuation, namely, by using existing types.

The great point in favour is that it has worked successfully in practice. The Neill Robertson stretcher is available for the two-seater machines, and large numbers of sick can be carried in ordinary Vernons without any of the disadvantages discussed in paragraphs 1 and 2 above, i.e., it involves no increased expenditure, no special personnel, and pilots under normal conditions would perform their ordinary work.

The disadvantage is the discomfort caused to the sick in the Vernon type and exposure—especially in cold climates—in the Neill Robertson stretcher.

Let us consider these two points separately.

(*a*) *Suitability of Vernons.*—The essential drawbacks were the acute discomfort of the seating arrangements and draughtiness of the hull owing to the gauze windows.

As a result of the experience gained in Iraq, a proposal was forwarded to the Air Ministry suggesting that only very slight modifications were necessary to convert all existing Vernon machines for ambulance work when and as required.

The alterations involved were briefly:—

(1) Addition of two stretcher racks of the present type used in the Vernon ambulances.

(2) The type of folding deck chair used in the latter to be substituted for the present seating accommodation, which gives more actual room in the hull, when they are folded up, than there is at present.

(3) The small square door in the nose of the hull for loading stretcher cases in the Vernon ambulance to be added, as it would not interfere with existing bomb-sighting arrangements.

(4) Replacement of gauze in windows by mica or talc.

These proposals have been agreed to, and all new troop carriers are being so fitted.

This raises an important point, namely, using fighting personnel and transport for the conveyance of casualties in war. It is easy to visualize the possibility of large numbers of casualties being flown to appropriate hospitals either in England or behind the lines in the case of another European war in which we are involved, as all our troop carriers and possibly heavy bombers will have accommodation for casualties and will merely have to collect them at landing grounds on their return empty from bombing raids or after landing troops. The lives, time and money saved this way would be a very potent factor in its favour, but might involve risk, as aircraft operating in this way could not expect protection under the Geneva Convention. The formation of special aerial ambulance squadrons at the outbreak of war would present many difficulties, in particular the provision of special personnel and machines at a time when very few pilots could be spared and every new machine turned out would be wanted for fighting purposes.

Under the circumstances it would appear that this point should be brought forward for discussion at the next conference of the signatories to the Geneva Convention. Identification marks of fighting machines carrying casualties is a simple matter. Special colours or red crosses painted on wings and hull are not visible enough at distance, but streamers of a fixed length tied to tail-plane or struts would meet the case in day-time, and at night a pre-arranged flash lamp with a continuous signal might prove suitable.

(*b*) *Suitability of Neill Robertson Stretcher for Two-seater Machines.*— These are essentially for the emergency crash in the absence of aerial ambulances or troop carriers. The ease and rapidity with which they are fitted is a great asset in their favour. Admittedly they can be replaced advantageously with a small aerial ambulance such as the Avro Andover already described, but this immediately introduces various difficulties already discussed. Probably the most satisfactory solution would be to develop the smaller type of air ambulance *pari passu* with new types of fighting machines, and make definite provision for one in each squadron normally equipped with a similar type of fighting aircraft, on lines already discussed above. This, however, awaits further experience, and in the meantime the Neill Robertson stretcher fills a very real want for emergency work, especially in isolated flights separated by a considerable distance from their parent unit and hospitals, a circumstance more apt to occur overseas than at home. Under these conditions the inevitable exposure of the patient is less owing to warmer climatic conditions.

There is a further alternative to be considered for an emergency, namely, instead of waiting for an air ambulance to arrive to convey the injured pilot or passengers to hospital, or sending them by Neill Robertson stretcher direct, to convey them by road ambulance to the nearest (probably a cottage) hospital, and in the meantime wireless for a R.A.F.M.S. surgeon specialist and portable X-ray set to arrive at the first possible moment by air. This is much more feasible in the United Kingdom than abroad, where generally the patient has to be carried some distance to the nearest operating theatre.

Special stretchers for air ambulance work have been devised both in France and America, but I do not propose either to describe or discuss them here, as it appears to me essential that one type of stretcher only should be used by both army and R.A.F., to avoid moving a patient from one to another before he reaches hospital. The army stretcher has stood the acid test of the war successfully, and apart from its weight which might advantageously be reduced, there is little fault to find with it.

Contrasting French machines with our own, it appears to me that though they are ahead of us in having definitely incorporated ambulance machines in their fighting squadrons, the Breguet ambulance is inferior to the corresponding type in the R.A.F., namely, the Avro Andover, in lacking wireless, having a smaller load, less petrol capacity and a poorer performance.

The French have nothing to compare with the latest R.A.F. troop carriers, all of which are being fitted for ambulance work as required, and one of which can carry as many patients as five Breguets.

French experience in Morocco has led to roughly the same conclusions as those reached in the R.A.F. through our experiences in Iraq, and it would be as well to recapitulate the French conclusions here, viz., that :—

(1) Special machines for sick are a necessity in overseas theatres.

(2) These must be of a standard Service type.

(3) The best pilots must fly them.

(4) The risk to patients is negligible, as no accident has yet occurred to one out of nearly 3,000 patients carried by air.

(5) Perfect liaison between ground and air forces is imperative and presents no real difficulty. Further experience only is required to obtain it.

I do not propose to discuss the possibilities of lighter than air machines as aerial ambulances in the present article, but unquestionably they should play a large part in future wars.

To sum up :—

(1) For single casualties the Neill Robertson stretcher, as modified for use in the R.A.F., is invaluable, especially in overseas commands in the absence of

(2) Single-engined aerial ambulances capable of accommodating at least one stretcher case and two sitting cases. Such machines should be developed along with new Service types and one should be part of every two- to three-seater squadron.

(3) The Avro Andover type, with its seven-hours petrol capacity, is ideal for routine evacuation of invalids from Iraq to Egypt throughout the year, but it suffers from the great disadvantage of being a special type. Ideal running conditions for invalids on the air route from Cairo to Baghdad must presuppose the use of aerial ambulances similar in type to Service machines in squadrons both at Cairo and Baghdad.

(4) The new Vernon troop carriers, modified for use as aerial ambulances, as and when required, are invaluable for evacuation of casualties on a large scale, but their use is still not clear under the Geneva Convention. If their use in this manner presents difficulties, aerial transport of sick in another European war can only take place if

(5) Special squadrons of large aerial ambulances of a similar type are built, but this will necessitate great delay and suitable pilots will be difficult to obtain.

In conclusion, I should like to point out that these notes do not pretend to give a comprehensive survey of the past, present or future of aerial transport of Service casualties. Many important points have been cursorily treated in order to keep the size of the article within reasonable bounds, but I trust that some of the points raised may prove of sufficient interest to promote further discussion on a subject so intimately associated with the alleviation of human suffering in war.

APPENDIX.

Type of machine	Engines	Max. speed	Touring speed	Landing speed	Size of cabin	Accommodation: Patients	Accommodation: Crew	Petrol capacity	Wireless	Special features
French Breguet 14 T bis aerial ambulance	Single 300 h.p. Renault	100 m.p.h.	?	?	Height 4′ 9″ Length 6′ 10″ Width 3′ 5″	2 stretcher cases 1 sitting case	1 Pilot	Hours 4½	No	Oxygen supplied to both stretcher cases, electrically heated blankets, ventilation under complete control
American Laddon ambulance plane	Single 375 h.p. Curtis	116 m.p.h.	?	40 m.p.h.	Height 5′ 5″	2 stretcher cases	1 Pilot 1 Orderly	3	No mention	Under construction
Vickers-Vernon ambulance 1st type	Twin engines 450 h.p. Napier Lion	119·5 m.p.h.	90 m.p.h.	50 m.p.h.	17′ long 6′ high 3′ 8″ wide	4 stretcher cases	2 Pilots 1 Wireless Operator 1 Fitter 1 Orderly	4	Yes, in air and on ground	Oxygen to all 4 stretchers. Electrically lit. Electric body warmers and kettle. Wash-basin and w.c. Ventilation by electric fan in forward bulkhead and ventilators in rear. Triplex glass windows. Stretcher cases loaded through nose of machine
Vickers-Vernon ambulance 2nd type	do.	119·5 m.p.h.	90 m.p.h.	50 m.p.h.	17′ long 6′ high 3′ 8″ wide	2 stretcher cases; up to 10 sitting cases dependent on size of crew and distance to be covered	2 Pilots 1 W.O. 1 Fitter 1 Orderly	4	do.	2 stretcher cases. 10 special folding chairs also used by crew, apart from pilots. Electrically lit. Oxygen. Ventilation from slip-stream of propellers through hinged forward windows. Wash-basin and electric body warmers omitted. Windows gauze throughout
Latest type Vernon troop carrier and ambulance	do.	119·5 m.p.h.	90 m.p.h.	50 m.p.h.	17′ long 6′ high 3′ 8″ wide	Do., but new type of folding chair	2 Pilots 1 W.O. 1 Fitter 1 Orderly	9	do.	2 stretcher cases. 6 double folding chairs looking sideways and not forward. Transparent wind-proof windows. Stretcher cases loaded through nose of machine
Avro Andover ambulance	Single 650 h.p. Rolls Condor. Auxiliary starting motor	106 m.p.h.	85 m.p.h.	50 m.p.h.	18′ long 6′ high 4′ 8″ wide	2 stretcher cases; up to 4 sitting cases	1 Pilot 1 W.O. 1 Orderly	7	Yes	The 2 stretcher racks when in use take the place of the 2 rear folding chairs. Triplex glass windows. Ample locker accommodation for kits, etc. Heating from outside of exhaust pipe. Electric kettle. W.C.

LABORATORY RESEARCH ON BACILLARY DYSENTERY.

By Brevet Lieutenant-Colonel H. MARRIAN PERRY.
Royal Army Medical Corps.

In a recent contribution by Dr. Manson-Bahr to the "Correspondence Circle" of this Journal on the subject of research on the more common tropical diseases the following important points in the laboratory examination of cases of bacillary dysentery are mentioned as worthy of further observations: (*a*) The persistence of dysentery bacilli in the fæces of convalescents; (*b*) the value of serum reactions in the diagnosis of the acute and chronic disease.

There is little doubt that more extensive study of these questions, and indeed of every aspect of this disease, cannot but lead to its better understanding. At the same time the impression may be formed by perusal of the note referred to that the knowledge we already possess on the above points is meagre. A brief account, therefore, of the writer's experience of these problems, much of which has been published, may be of interest and assistance to those contemplating the pursuit of these investigations.

The Persistence of the Dysentery Bacilli in the Fæces during the Convalescent Stage of the Disease and during the "Carrier State."

Much information on this question is embodied in an article on Bacillary Dysentery by Manson-Bahr and the writer in "The Practice of Medicine in the Tropics" (Byam and Archibald).

The incidence of the carrier condition has been investigated by various observers in several large groups of cases, and has been found to vary from three to seven per cent. The duration of the period of infectivity of convalescents has, in the writer's experience, been very largely dependent on the clinical condition of the patient. It is possible, of course, that the mildest case may be a potential carrier, but it was found that the period of elimination of dysentery bacilli was most often prolonged in the chronic relapsing type of the infection. In these latter cases clinical evidence of some chronic ulceration of the bowel was obvious, and amelioration of the symptoms coincided with the disappearance of the organisms from the stools.

Observations on this point, extending over a period of twelve months were made by the writer at the Central Dysentery Hospital established in England for the reception of these cases from abroad. From the data obtained by these investigations the following table (from "The Practice of Medicine in the Tropics") was compiled, and is illustrative of a large series of cases in the "carrier state."

Chronic Carriers of *Bacillus dysenteriæ* Shiga. 67 Cases.

	Per cent.
Positive four months from onset	77
,, six months from onset	19
,, twelve months from onset	4

CHRONIC CARRIERS OF *Bacillus dysenteriæ* FLEXNER. 271 CASES.

		Per cent.
Positive	four months from onset	59
,,	six months from onset	34
,,	twelve months from onset	7

In the very great majority of the cases included in the above table the persistence in the stools of small quantities of mucus was evidence that the chronic inflammatory condition of the bowel had not entirely subsided. Beyond an occasional mucoid stool, however, the patients were in fair health and actual typical relapse was infrequent. Briefly, the clinical condition was that which has been termed by Cunningham "latent dysentery." In such cases bacteriological examination of the stools yielded most irregular results, positive and negative examinations alternating, or occasionally a positive result following a series of negative indicated the continued infectivity of the patient. This intermittent elimination of the infecting organism discounts to an important degree the value of a series of negative bacteriological examinations as indicating the non-infectivity of any dysentery convalescent.

A macroscopic and microscopic examination of the stool is easily and rapidly made and will indicate the presence or absence of mucus, or of mucus and blood. The result of such an examination may be accepted as a useful criterion as to whether the convalescent is a potential source of danger to the community. This method is undoubtedly the only practical way of dealing with the question when the investigation of large numbers of individuals has to be undertaken.

From the foregoing remarks it will be evident that the experience gained in the examination of cases in this stage of the disease suggests that although the "carrier" of dysentery bacilli, especially of *Bacillus dysenteriæ* Flexner, may present symptoms so mild as to be readily overlooked, his condition of health could not be described as normal.

SERUM REACTIONS IN THE DIAGNOSIS OF BACILLARY DYSENTERY.

The sero-diagnosis of bacillary dysentery is also suggested as a subject for re-investigation by the *macroscopic* technique of agglutination. The fact that the macroscopic method is emphasized in the note to which reference has been made may possibly create the impression that all previous investigation of serum reactions in these infections has been undertaken by the now archaic microscopic method of applying this test. It is hardly necessary to remind laboratory workers who have passed through the classes at the Royal Army Medical College that the technique which should be adopted is the macroscopic, a method with which they are thoroughly familiar. It may be helpful, however, to those investigating this aspect of the disease to record shortly the writer's experience of this method of examination in infections with *B. dysenteriæ* Shiga and the various serological strains of *B. dysenteriæ* Flexner.

The observations about to be recorded were made in the closing phase

of the war at a period when bacillary dysentery, mainly of the Flexner type, constituted a serious cause of disability and invalidism. Opportunity of continuing these observations in the more chronic type of the infection was afforded by the examination of a large number of convalescents at the Central Dysentery Hospital subsequent to the armistice.

The Period of the Disease at which Agglutinins appear in the Serum.

Cases came under observation at stages of the disease varying from the fourth to the thirty-second day from the onset. The presence of demonstrable agglutinins was noted in some cases as early as the fifth or sixth day, but more commonly after the tenth day.

In all cases the tests were made with standard agglutinable emulsions of the various dysentery bacilli and, in addition, in many instances with formalinized broth cultures of the actual organism isolated from the patient.

The Quantitative Estimation of Agglutinin Production.

In making any accurate observations relative to this point the employment of standardized agglutinable emulsions is obviously a very great advantage. In the absence of standardized suspensions, formalinized broth cultures made from type strains of the various organisms and diluted down to the required opacity, will be found to yield most useful and consistent results.

It may be stated at once that the titre of the patient's serum in which positive agglutination of the infecting organism is evident is always low and is in no way comparable to that seen in typhoid or paratyphoid infections. The degree of agglutinin production in bacillary dysentery is largely dependent on the clinical type of the case, and on the identity of the infecting dysentery bacillus. In general, the more severe the symptoms developed during the course of the disease the higher was the serum dilution in which a positive reaction was evident, and Shiga infections invariably yielded more powerful reactions than infections with the mannite-fermenting group of bacilli.

Passing from these generalizations, the following brief details are illustrative of the results obtained in the serological investigation of these cases. Those more especially interested in this question should refer to the Medical Research Council Special Report Series, No. 42, p. 45, where specific details of the serum reactions of a group of cases infected with the mannite-fermenting bacilli are recorded.

In Shiga infections the titre of the serum in which positive agglutination occurred was frequently as high as 1 in 250, exceptionally 1 in 500, and in rare cases 1 in 1,000. No case of Shiga dysentery, proved by actual isolation of the organism, failed to give positive evidence by the production of agglutinins of the existence of the infection. In the milder type of case clumping of the suspension might be evident only in dilutions

as low as 1 in 25, but as the test always included a range of dilutions of from 1 in 25 to 1 in 250, positive results were not missed.

It has been suggested that "normal" sera, i.e., sera of individuals who have not suffered from a Shiga infection, may agglutinate suspensions of this bacillus in low dilution. This fallacious result has not been experienced, and provided that the agglutinable emulsion employed in the test is selected and controlled in the usual manner, reliance can be placed on positive serum reactions in Shiga infections.

There are, however, a few precautions which must be observed in interpreting the result of a positive reaction. The history of the patient must be carefully ascertained, and the occurrence of a previous Shiga infection must, if possible, be excluded, as agglutinins for the organism may persist in the serum for some years subsequent to the infection. In several individuals, from whom the history of a previous attack of Shiga dysentery was elicited, the writer has found the serum to give a positive agglutination reaction in a dilution up to 1 in 125 for as long as from two to three years following the original infection. The fact that an anti-dysentery serum is commonly administered to these cases at an early stage in treatment should also be borne in mind and the patients' serum must be obtained *before* the injection of Shiga anti-toxin. The reasons for this precaution are, of course, obvious.

In Flexner dysentery the application of the agglutination test is complicated by the fact that several closely related serological strains of mannite-fermenting bacilli may be responsible for the infection. Agglutinable emulsions for these various organisms can, however, be readily prepared and the serum tested against each strain.

A *negative* reaction cannot be assessed at as high a value as has been noted in infections with the Shiga bacillus. Whereas in the latter type of dysentery a serum test has invariably yielded positive evidence of agglutination, in the case of the mannite-fermenting bacilli twenty to thirty per cent of the cases examined failed to demonstrate the production of agglutinins for the infecting bacillus. It has been noted that the extent to which agglutinins are elaborated is dependent on the severity of the infection. The explanation, therefore, of these negative reactions apparently lies in the fact that in certain cases the symptoms produced by the Flexner group of bacilli may be mild and transient in nature; it is a commonplace that they are frequently diagnosed clinically as "diarrhœa."

In *positive* reactions the titre of the serum in which agglutination of the infecting organism is evident, whilst varying with the severity of the infection, is, in general, low. In a series of cases proved by isolation of the V-strain of bacillus, positive reactions were noted in dilutions of from 1 in 25 to 1 in 125. Although agglutination might occasionally occur in a dilution of 1 in 250 or over, cases yielding these more marked reactions were uncommon.

The agglutination of one or other of the mannite-fermenting bacilli by "normal" sera, i.e., sera of individuals who do not give a previous history

of Flexner dysentery, must be noted as complicating the interpretation of the test in these infections. This phenomenon is not infrequently observed if the agglutination reactions of the sera of a number of healthy individuals are investigated. The probable explanation of these results is that a previous Flexner infection has occurred, but has been so mild that a bacteriological examination of the fæces has not been made and the true nature of the case has passed unrecognized. A possible alternative explanation is that such individuals may have ingested subinfectious doses of these organisms and, although actual infection has not resulted, demonstrable antibodies have been produced. Evidence in support of both these hypotheses has been placed on record by several observers, and the writer's experience is that agglutination of the mannite-fermenting strains by so-called "normal" sera is to be observed most commonly in endemic areas of these infections.

A further point relative to the presence in the serum of "normal" agglutinins for the Flexner bacilli is worthy of notice. It can frequently be determined that in pure Shiga infections, that is to say cases in which careful and repeated bacteriological examination of the stools has resulted in the isolation of *B. dysenteriæ* Shiga only, in addition to the production of agglutinins for this organism, any Flexner agglutinins present are markedly increased. The phenomenon is somewhat analogous to the commonly observed fact that paratyphoid infections in patients who have previously been inoculated with a *typhoid* vaccine usually causes a rise in titre of the typhoid inoculation agglutinins. Unless the possibility of this occurrence is recognized an incorrect diagnosis of a mixed infection might be made on the result of a serological test which indicates the presence of both Shiga and Flexner agglutinins.

In cases of chronic dysentery a serological examination should always be made, as valuable information suggestive of a previous bacillary infection may be obtained. More especially is this the case in Shiga infections, for residual agglutinins for this organism may, as has been previously noted, persist in the serum for years. It has recently been the practice at the Queen Alexandra Military Hospital, London, to test the serum of chronic and relapsing cases of dysentery in which, as is usual, unsuccessful attempts have been made to isolate a dysentery bacillus. Certain of these cases have yielded evidence which might be indicative of the nature of the primary infection, but the difficulty of interpreting positive results, in so far as the mannite-fermenting bacilli are concerned, must be emphasized.

As Manson-Bahr has rightly indicated, all the points referred to above might usefully be re-investigated. Opportunity for this research exists in India, as it is probable that, notwithstanding the general impression to the contrary, bacillary dysentery is much more common amongst British troops in that country than the amœbic infection.

This communication, recording a few observations made during some years' laboratory experience of these problems, may be of interest to officers engaged in this work.

FURTHER INVESTIGATION INTO THE STERILIZATION OF WATER BY CHLORINE AND SOME OF ITS COMPOUNDS.

By Major C. H. H. HAROLD.

Royal Army Medical Corps.

"There is no safe method of preventing water-borne diseases except sterilization of the liquid."
—Rideal.

(*Continued from p.* 273.)

Part II.—New Series.

EPITOME OF EXPERIMENTS.

Part II.—Tank and Laboratory Experiments.

To obtain more definite information regarding the action of these compounds in natural waters, and the significance of the titration results, it appeared necessary to use tanks without baffles and 11-gallon glass tanks were acquired.

Series A.

Experiment—

(1) Pouring experiment in tanks.

0·75 NH_3 poured into tank, count 5, 1·5 Cl_2 added, count 5, and stir.

Titration, N/100 thiosulphate solution .. 355 c.c. $= \frac{0{\cdot}7 \quad 0{\cdot}7}{1{\cdot}4}$

Remarks.—Equal proportions of free and combined fractions. Practically no loss.

(2) Using full cart dose, theoretical titration should be 15.

$$355 \text{ c.c.} = \frac{9{\cdot}5 \quad 2{\cdot}2}{11{\cdot}7}$$

Considerable loss.

(3) Repeat (1), using 1·1 p.p.m. NH_3 and 1·5 Cl_2 tank dose.

$$\text{Tank titration} = \frac{1{\cdot}0 \quad 0{\cdot}45}{1{\cdot}45}$$

Increase of NH_3 has led to increase in free fraction, which is unexpected.

(4) Repeat (2), using proportions of 1·1 NH_3 to 1·5 Cl_2 (cart dose).

$$\text{Titration} = \frac{8{\cdot}0 \quad 3{\cdot}0}{11{\cdot}0}$$

Increase in loss. Cf. (2).

Series B.—New Series.

The Effect of Ammoniacal Content of Water :—

Experiment—

(1) Water containing : 1 p.p.m. free NH_3
1 p.p.m. ammon. carb.
1 p.p.m. ammon. chlor. } 3 p.p.m.

Pouring 1 NH_3 + 2 Cl_2 in the usual way, titration .. .. $= \frac{0\cdot9 \quad 0\cdot9}{1\cdot8}$

Now add an additional two parts per million of NH_3 .. $\frac{0\cdot7 \quad 1\cdot0}{1\cdot7}$

" " " " " after 1 hour $\frac{0\cdot65 \quad 0\cdot95}{1\cdot5}$

After 3 hours, $\frac{0\cdot7 \quad 0\cdot4}{1\cdot1}$ 7 hours, $\frac{0\cdot5 \quad 0\cdot5}{1\cdot0}$ 24 hours $\frac{0\cdot6 \quad 0\cdot3}{0\cdot9}$

52 hours, $\frac{0\cdot7 \quad 0\cdot1}{0\cdot8}$

Hence, in spite of the addition of relatively large amounts of ammonia, these compounds show considerable power of resistance, and ammonium chloride is not formed.

In the loss which ensues, is it the free fraction which disappears first and a gradual conversion of combined to free, or a straight loss of second fraction ?

(2) The effect of adding NH_3 to water containing Cl_2 in solution. Adding 2 p.p.m. of Cl_2 to a tank and half an hour's contact allowed for absorption.

Titration = 1·5 p.p.m.

Add 2 p.p.m. NH_3 and mix. After 1 hour, titration $= \frac{1\cdot2 \quad 0\cdot0}{1\cdot2}$;

after 3 hours = 1·0 0·0; 7 hours $= \frac{1\cdot0 \quad 0\cdot0}{1\cdot0}$

" 24 " $= \frac{0\cdot85 \quad 0\cdot0}{0\cdot85}$; 52 " $= \frac{0\cdot85 \quad 0\cdot0}{0\cdot85}$

All on free side. This body, known to have slow germicidal velocity, is also slowly absorbed. *Vide* cart experiment F (3).

Series C.

Repetition of cart experiments done in 11-gallon tanks under more favourable conditions. Ammonia solution made up to same volume as Cl_2 solution, using 0·5 NH_3 and 1 Cl_2 p.p.m.

Experiment.

(1) Ammonia poured as usual, NH_3 first, count 5, add Cl_2, count 10, mix.

After 15 minutes $= \frac{0\cdot3 \quad 0\cdot5}{0\cdot7}$; 30 minutes $= \frac{0\cdot3 \quad 0\cdot45}{0\cdot8}$

(2) Solutions run by two-way tube.

15 minutes $= \frac{0\cdot2 \quad 0\cdot3}{0\cdot55}$; 30 minutes $= \frac{0\cdot2 \quad 0\cdot3}{0\cdot5}$

Repeated experiment $= \frac{0\cdot2 \quad 0\cdot3}{0\cdot45}$

Remarks.—Note loss, cf. (1).

(3) Pour streams of NH_3 and Cl_2 on surface of water. Streams near and not mixing.

15 minutes $= \frac{0\cdot45 \quad 0\cdot15}{0\cdot7}$; 30 minutes $= \frac{0\cdot4 \quad 0\cdot2}{0\cdot7}$

Remarks.—Not as good as (1).

(4) Pouring solutions simultaneously through funnel.

15 minutes $= \frac{0\cdot2 \quad 0\cdot3}{0\cdot5}$

Remarks.—Similar to two-way tube results (2).

(5) Using ammonium carbonate 1/2 part instead of NH_4OH.

$$\text{Pouring} = \frac{0{\cdot}8 \quad 0{\cdot}3}{0{\cdot}8}$$

Remarks.—Good. Cf. (1).

(6) Ammon. carb. as solution with two-way tube simultaneously with Cl_2. No Cl_2 titratable.

Remarks.—Very important.

(7) Repeated, pouring ammon. carb. a little in advance of the Cl_2 solution with little Cl_2 to finish up with.

$$15 \text{ minutes} = \frac{0{\cdot}3 \quad 0{\cdot}3}{0{\cdot}6}$$

Remarks.—Not so good as ammonia.

(8) Mix NH_3 with water and allow to stand five minutes. Run in Cl_2 and stir immediately.

$$15 \text{ minutes} = \frac{0{\cdot}6 \quad 0{\cdot}15}{0{\cdot}7}$$

Remarks.—A very good titration, but we cannot get the rapid mixing in the carts.

Experiment.

(9) Pour Cl_2 first, followed by NH_3.

$$15 \text{ minutes} = \frac{0.7 \quad 0{\cdot}0}{0{\cdot}7}$$

Ammonia fixed and all on free side. Killing power will be poor: absolutely no second fraction. *Vide* 2 D and cart experiment F (3).

Remarks.—General inference that for small-bulk samples 11 to 110 gallons, pouring one solution through another gives good and regular titration results, and the germicidal power is of a high order. The clear first fraction result obtained by dosing the Cl_2 first is worthy of note.

Series D.

What is the effect of the interval between dosing NH_3 and Cl_2 on titration figures—using 1 Cl_2 and 0·5 NH_3 (tank dose)?

(1) Pour NH_3, count 5, stir, add Cl_2, count 10, stir later.

$$\text{Titration} = \frac{0{\cdot}3 \quad 0{\cdot}35}{0{\cdot}65}$$

(2) Pour NH_3, count 5, add Cl_2, stir immediately.

$$\text{Titration} = \frac{0{\cdot}6 \quad 0{\cdot}1}{0{\cdot}7}$$

(3) Half fill tank, pour NH_3, count 5, add Cl_2, leave five minutes and fill up.

$$\frac{0{\cdot}4 \quad 0{\cdot}4}{0{\cdot}8}$$

Remarks.—Effect of rapid mixing is to give a large first fraction, with longer contact, and a stronger Cl_2 solution diffusing through a dilute NH_3, a larger second fraction is obtained.

Series E.

Attempts at making concentration solutions and minimizing loss.

Experiment.

(1) Using a cart dose in 11-gallon tank = 10 p.p.m. Cl_2 and 5 p.p.m. NH_3
NH_3 poured first, count 10, add Cl_2, mix.

$$\text{Titration} = \frac{0\cdot5 \quad 0\cdot34}{8\cdot4} = 16 \text{ per cent loss when } 1/10 \text{ bulk of water in use.}$$

(2) Using 3·36 cart doses = 33·6 p.p.m. Cl_2 and half amount of NH_3.

$$\frac{6\cdot0 \quad 9\cdot0}{25} = 26 \text{ per cent loss.}$$

(3) Using 9 cart doses = 90 p.p.m. Cl_2 added and half quantity NH_3 as above.

$$\text{Titration} = \frac{31\cdot0 \quad 21\cdot0}{52\cdot0} = 43 \text{ per cent loss.}$$

(4) Repeated (2).

$$\text{Titration} = \frac{13\cdot5 \quad 8\cdot0}{21\cdot5} = \text{loss of } 29 \text{ per cent.}$$

Series E shows that the pouring method when used for the production of high concentrations has limited possibilities.

Series F.

Using ammon. carb. with and without ammonia in water.

Experiment.

(1) Pouring ammon. carb. 1/2 part, followed by 1 Cl_2.

$$\text{Titration} = \frac{0\cdot4 \quad 0\cdot28}{0\cdot65}$$

(2) Tank containing 5 p.p.m. of NH_3. As in (1).

$$\text{Titration} = \frac{0\cdot0 \quad 0\cdot65}{0\cdot65}$$

Remarks.—Effect of excess NH_3 on titration is striking.

Effect of using two-way tube with various ratios of Cl and NH_3, allowing solutions to diffuse into tanks.

Volume of NH_4 solution the same as Cl_2 (tank dose).

(3)

1 Cl_2	1/2	NH_3.	Immediate	titration	$= \frac{0\cdot22 \quad 0\cdot22}{0\cdot44}$
,,	1/5	,,	,,	,,	$= \frac{0\cdot35 \quad 0\cdot15}{0\cdot5}$
,,	1/8	,,	,,	,,	$= \frac{0\cdot22 \quad 0\cdot3}{0\cdot5}$
,,	1/10	,,	,,	,,	$= \frac{0\cdot5 \quad 0\cdot3^*}{0\cdot8}$
,,	1/12	,,	,,	,,	$= \frac{0\cdot5 \quad 0\cdot3}{0\cdot8}$
,,	1/16	,,	,,	,,	$= \frac{0\cdot5 \quad 0\cdot3}{0\cdot8}$
,,	1/20	,,	,,	,,	$= \frac{0\cdot5 \quad 0\cdot3}{0\cdot8}$

* Great reduction in loss at this point.

(4) Using cart dose in tank.

$$\text{Proportion of } 1/5\ NH_3 \text{ to } 10\ Cl = \frac{3\cdot5 \quad 2\cdot0}{5\cdot5}$$

$$\text{,, ,, } 1/10 \text{ ,, ,, } = \frac{3\cdot0 \quad 4\cdot0}{7\cdot0}$$

$$\text{,, ,, } 1/15 \text{ ,, ,, } = \frac{4\cdot0 \quad 3\cdot0}{7\cdot0}$$

Out of a possible 10 parts per million.

(5) Try out in the cart with two-way tube.

$$1\ Cl_2\ 1/5\ NH_3 = \frac{0\cdot1 \quad 0\cdot2}{3\cdot0}$$

,, 1/10 ,, = wash-out owing to absorption of free chlorine

Series G.

Is it possible to obtain combining ratios of NH_3 and Cl_2 other than 1 to 4 and 1 to 2? (Cart dose = 10 p.p.m.)

(1) Mix in beaker one minute and pour into tank and mix.

Pro ratio of 1/6 NH_3 to 1 Cl_2 titration figure	= 4	+ 1·5	=	total	5·5	p.p.m.
,, ,, 1/10 ,, ,, ,,	= 5·0	+ 1·0	=	,,	6·0	,,
,, ,, 1/2 ,, ,, ,,	= 1·8	+ 1·8	=	,,	3·6	,,
,, ,, 1/5 ,, ,, ,,	= 5·0	+ 1·5	=	,,	6·5	,,
,, ,, 1/20 ,, ,, ,,	= 7·0	+ 0·01	=	,,	7·01	,,
Repeat 1/20	= 8·0	+ 0·0	=	,,	8·0	,,

1/10 is lowest dose which gives a second titration figure.

(2) Solutions of equal volume containing a smaller ratio of NH_3 by weight.

1 NH_3 + 10 Cl_2. Mix at once in beaker and pour into tank.

$$\text{Immediate titration} = \frac{5\cdot7 \quad 1\cdot3}{8\cdot0}; \text{ later} = \frac{3\cdot5 \quad 1\cdot0}{4\cdot5}$$

Remarks.—Great loss.

(3) Two-way tube: 1 NH_3 + 10 Cl_2 equal volumes into 11-gallon tank.

$$\text{Immediate: } \frac{5\cdot5 \quad 2\cdot2}{7\cdot7}; \text{ later: } \frac{3\cdot0 \quad 3\cdot0}{6\cdot0}$$

Pouring through a small funnel together.

$$\text{Immediate: } \frac{5\cdot5 \quad 2\cdot0}{7\cdot5}; \text{ later: } \frac{3\cdot0 \quad 3\cdot6}{6\cdot6}$$

Remarks.—When ratios of 1/4 and 1/2 of NH_3 to 1 Cl are brought together in these concentrations an initial loss of available Cl_2 results, but ratios of 1/10 NH_4 to 1 Cl_2 lead to subsequent loss in water. This is what takes place in the cart when using lower ratios of NH_3.

(4) Using water cart dose = 10-fold tank dose. Add NH_3, count 5, add 10 Cl_2, leave half a minute, stir.

	¼ hour	½ hour	¾ hour	1 hour
1/2 NH_3 ..	$\frac{5\cdot0 \quad 2\cdot5}{7\cdot5}$	$\frac{4\cdot9 \quad 2\cdot8}{7\cdot6}$	$\frac{4\cdot5 \quad 3}{7\cdot5}$	$\frac{4\cdot5 \quad 2\cdot7}{7\cdot2}$
1/4 NH_3 ..	$\frac{7\cdot0 \quad 1\cdot5}{8\cdot5}$	$\frac{6\cdot7 \quad 1\cdot9}{8\cdot4}$	$\frac{7\cdot0 \quad 0\cdot9}{7\cdot9}$	$\frac{6\cdot5 \quad 1\cdot4}{7\cdot9}$
1/10 NH_3 ..	$\frac{6\cdot0 \quad 2\cdot5}{8\cdot5}$	$\frac{2\cdot7 \quad 2.3}{5\cdot0}$	$\frac{2\cdot7 \quad 0\cdot3}{3\cdot0}$	$\frac{2\cdot5 \quad 1\cdot0}{3\cdot0}$

1/10 does not hold, *vide* large drop (absorption) between $\frac{1}{4}$ and $\frac{1}{2}$ hour.

(5) Effect of pouring when cart or tank is half full, using a tank dose, waiting one minute and then filling up tank with water.

$\frac{1}{2}$ NH_3 + 1 Cl_2 (10 Cl_2), wait one minute, fill up. $\frac{4\cdot8 \quad 2\cdot1}{6\cdot9}$

Some loss compared with previous experiment.

Series H.

Experiment.—(1) Effect of adding excess of base to tank, 5 p.p.m. (tank doses).

$$\tfrac{1}{4}\,NH_4 + 1\,Cl_2 \text{ (2-way tube)}: \frac{0\cdot0 \quad 0\cdot3}{0\cdot3};\ \tfrac{1}{2}\,NH_4 + 1\,Cl_2: \frac{0\cdot0 \quad 0\cdot3}{0\cdot3}$$

Note.—Small second fraction due to excess of base and loss through two-way tube.

(11) Same as above, but pouring one solution through the other, as in the cart.

$$\tfrac{1}{4}\,NH_3 + 1\,Cl_2 = \frac{0\cdot3 \quad 0\cdot3}{0\cdot6};\ \tfrac{1}{2}\,NH_3 + 1\,Cl_2 = \frac{0\cdot4 \quad 0\cdot2}{0\cdot6}$$

These are immediate titrations, but if left longer an increasing second fraction would probably be noted.

Series I.

Effect of prolonged contact of Cl_2 with dilute ammonia in proportions of $\frac{1}{4}$ NH_3 to 1 Cl_2 in increased concentration.

Eleven-gallon tank, mix in $\frac{1}{4}$ part NH_3 = dose for a cart, add corresponding amount of chlorine by funnel to bottom of tank, leave for $\frac{1}{2}$ hour, stir slowly $= \frac{1\cdot5 + 6\cdot0}{7\cdot5} =$ 28 per cent. loss.

Note.—Large second fraction and satisfactory return.

Series J.

Germicidal Activity.

Experiment 1.—A comparison of the germicidal power of various compounds in 11-gallon tanks, each containing an addition of 25 c.c. of broth culture of *B. coli*: 1,000 million per c.c.

Available chlorine added = 1 p.p.m., dosed from 2-litre flasks.

Ammonium	hypochlorite:	$\frac{1}{4}$ NH_3 1 Cl.	$\frac{1}{4}$ NH_3 1 Cl.	$\frac{1}{2}$ NH_3 1 Cl.	$\frac{1}{4}$ ammon. carb. 1 Cl.
Plating: $\frac{1}{2}$ hour:	Some 200 or 300 cols.	33 cols.	15 cols.	Negative	Enormous film of growth
1 hour:	Negative	Negative	Negative	Negative	Some thousands colonies
Titration:					
$\frac{1}{4}$ hour:	$\frac{0\cdot65 \quad 0\cdot05}{0\cdot7}$	$\frac{0\cdot05 \quad 0\cdot65}{0\cdot7}$	$\frac{0\cdot04 \quad 0\cdot65}{0\cdot7}$	$\frac{0\cdot3 \quad 0\cdot4}{0\cdot7}$	$\frac{0 \quad 0\cdot7}{0\cdot7}$
$\frac{1}{2}$ hour:	$\frac{0\cdot55 \quad 0}{0\cdot55}$	$\frac{0\cdot05 \quad 0\cdot6}{0\cdot65}$	$\frac{0\cdot05 \quad 0\cdot6}{0\cdot55}$	$\frac{0\cdot3 \quad 0\cdot35}{0\cdot65}$	$\frac{0 \quad 0\cdot6}{0\cdot6}$

Remarks.—Note superiority of mixtures of equivalents of Cl_2 and NH_3 and also of $\frac{1}{2}$ equivalent of NH_3 and 1 of Cl_2 over hypochlorite. Note typical titrations of these compounds. Note ammon. carb. entirely second fraction titration—action not so rapid. Hypochlorite contains excess NH_3 as it is made by double decomposition of bleach and ammon. oxalate.

Experiment 2.—A comparison of the germicidal powers of various compounds against 25 c.c. broth culture (1,000 million organisms per c.c.) in 11-gallon tank.

	1·25 Cl_2 + 0·625 NH_3 by pouring method	Hypochlorous acid 1 p.p.m.	Hypochlorous acid + ½ NH_3 by pouring method	Cl_2 1 p.p.m. + $\frac{1}{15}$ NH_3 mixed first and dosed	Cl_2 1 p.p.m.
Plating:					
½ hour ..	Sterile	Enormous film	Some hundreds	Enormous film of growth	Enormous film
1 ,, ..	,,	,,	Sterile	3 cols.	Some hundreds
Titration:					
½ hour ..	0·3 0·35 / 0·65	0·1 0·3 / 0·4	0·15 0·3 / 0·45	0·15 0·35 / 0·5	0·2 0·2 / 0·4
1 ,, ..	0·25 0·3 / 0·55	0 0·25 / 0·25	0·1 0·3 / 0·4	0·1 0·35 / 0·45	0·2 0·25 / 0·4

Remarks.—Hypochlorous acid is more rapidly absorbed than Cl_2 and not so effective. The attachment of hypochlorous acid to ammonia results in enhanced germicidal action. The second titration given by Cl_2 and hypochlorous acid is due to the broth culture which on Nesslerizing showed the presence of ammonia and possibly the combination of Cl_2 with protein or protein derivatives.

Experiment 3.—The effect of interaction of hypochlorous acid and ammonia, (A) by mixing solutions of equal volume containing equivalents of NH_3 and HClO, a solution was made with negligible bleaching powers and having a chloramine smell. (B) By pouring strong HClO into very dilute NH_3, and mixing the while, a solution with considerable bleaching powers but without the chloramine smell resulted.

Dosed into 11-gallon tanks, containing 25 c.c. broth culture.

Estimated available chlorine content = 1 p.p.m.

	(A)		(B)
Plating, ¼ hour ..	Some hundreds		69 cols.
,, ½ ,, ..	5 cols		34 ,,
,, ¾ ,, ..	2 ,,		17 ,,
Titration, ¼ ,, ..	0·1 0·9 / 1	¾ hour ..	0 0·5 / 0·5
,, ½ ,, ..	0·1 0·4 / 0·5	21 hours ..	0 0·4 / 0·4
,, 48 hours ..	0 0·25 / 0·25	48 ,, ..	0 0·2 / 0·2

Remarks.—From the titrations it would appear that both (A) and (B) seem to change over to chloramine. The compound (B) which originally possessed a bleaching action does not prove to be superior to (A), and is not superior to hypochlorite made by double decomposition (*vide* Experiment 1 of this series). Note absorption of both compounds by the water.

Experiment 4.—Comparative results obtained when using Cl_2 alone; Cl_2 with an equivalent of NH_3 and chlorine with varying ratios of NH_3 by weight. The solutions allowed initial contact in 2-litre flasks and then poured into tanks. Broth culture 25 c.c., 2,000 million *B. coli* per c.c., added to each 11-gallon tank.

	A	B	C	D	E
	Cl_2 alone 1·25 p.p.m.	Cl_2 1·25 p.p.m. + 0·625 NH_3	Cl_2 1·25 + a ratio of $\frac{1}{15}$ NH_3	Cl_2 1·25 + a ratio of $\frac{1}{16}$ NH_3	Cl_2 1·25 + $\frac{1}{4}$ NH_3 0·3125
Plating:					
½ hour ..	Massive film of growth	103 cols.	Massive film as in (A)	As in (C)	Negative
1½ ,, ..	As above	Negative	Massive film lighter than above	Some hundreds cols.	Negative
Titration:					
1 hour ..	0·15 0·35 0·5	0·2 0·4 0·6	0·1 0·5 0·6	0 0·7 0·7	0·2 0·5 0·7

Remarks.—Note inferiority of Cl_2 and ratios of NH_3 lower than 1 to 4. Second titration with Cl_2 probably due to ammonia in broth and compounds of chlorine and protein.

Experiment 5.—The effect of contact of varying ratios of NH_3 and Cl_2. Indicator: 25 c.c. broth culture.

Plating:	1 Cl_2 p.p.m. + ½ ammon. carb.	1 Cl_2 p.p.m. + 0·5 NH_3	1 Cl_2 p.p.m. + 1 NH_3	1 Cl_2 alone
½ hour ..	Some hundreds cols.	1 col.	4 cols.	Enormous film
1 ,, ..	Negative	Negative	Negative	,, ,,
Titration:				
1 hour ..	0·2 0·6 0·8	0·4 0·2 0·6	0·6 0 0·6	0·5 0 0·5

Remarks.—Ammon. carb. is effective; best combination is equivalents of Cl_2 and NH_3; note character of titration, also that of Cl_2 with two equivalents of NH_3; the latter similar in type to Cl_2 alone.

Experiment 6.—The influence of the contact period upon the titration results, etc., of the different combinations.

First method.—Five minutes' contact of Cl_2 with NH_3 in 2-litre flasks, without stirring, then mix; a further five minutes' contact, and finally dosed into 11 gallons. Amount of Cl present = amount calculated to give 1 p.p.m. in 11 gallons.

Second method.—Add NH_3, mix at once; add Cl_2, mix at once, pour. Indicator broth 25 c.c. = 2,000 million *B. coli* per c.c.

	A	B	C	D
Plating:	1 Cl_2 + 1 ammon. carb. (first method)	1 Cl_2 + 0·25 NH_3 (first method)	1 Cl_2 + 0·5 NH_3 (second method)	1 Cl_2 + 0·5 NH_3 (first method)
¼ hour ..	Some thousands	Big film growth	60 cols.	Film better than (B)
½ ,, ..	60 cols.	,, ,,	1 col.	Some thousands better than (B)
¾ ,, ..	14 cols.	,, ,,	Negative	25 cols.
Titration after ¾ hour	0·1 0·2 0·3	0 0·5 0·5	0·3 0 0·3	0·1 0·3 0·4

Remarks.—Ammon. carb. in this ratio very effective. Note that a total second-fraction titration does not mean improved germicidal action. "Mix at once and dose" proves to be the best method.

Experiment 7.—Ranging to find ideal combining ratios; also examination of titration results and germicidal power.

Standard dose Cl_2 1·25 p.p.m.; NH_3 given in proportionate weights. Dose for 11-gallon tanks allowed initial contact in 2-litre flasks. Add Cl_2 to ammonized water in flasks; wait three minutes, mix; wait three minutes, dose. Indicator: 25 c.c. broth culture.

	A	B	C	D	E
	1 Cl_2	1 Cl_2	1 Cl_2	1 Cl_2	1 Cl_2
	0·25 NH_3	0·5 NH_3	0·75 NH_3	1 NH_3	1·25 NH_3
Plating, 1 hour ..	11 cols.	Negative	Negative	Negative	1 col.
,, 1½ hours ..	Negative	,,	,,	,,	Negative
Titration	0·1 0·9 / 1·0	0·3 0·55 / 0·85	0·3 0·3 / 0·65	0·4 0·25 / 0·65	0·5 0·1 / 0·6

Remarks.—Note change of character of titration. Increasing ammonia ratios give a larger first fraction. Best germicidal ratio lies between ¼ to 1 of NH_3 to 1 of Cl_2.

Experiment 8.—Ranging to find ideal combining ratios of Cl_2 and NH_3 and to examine changes in the character of titrations. Cl_2 calculated to give 1·25 p.p.m. in 11 gallons added to ammonized water in 2-litre flasks; five minutes contact, mix; five minutes contact, pour. Indicator broth culture 25 c.c. NH_3 shown as ratios of Cl_2 by weight.

	A	B	C	D	E
	1 Cl_2	1 Cl_2	1 Cl_2	1 Cl_2	1 Cl_2
	+ ¼ NH_3	+ ½ NH_3	+ ¾ NH_3	1 NH_3	1¼ NH_3
Platings, 1 hour ..	Negative	47 cols.	Negative	13 cols.	Film of growth
,, 1½ hours ..	,,	Negative	,,	Negative	Mass of cols.
Titrations, ¼ hour ..	0·2 0·7 / 0·9	0·15 0·4 / 0·55	0·4 0·3 / 0·7	0·4 0·1 / 0·5	0·6 0·1 / 0·7
,, ½ ,, ..	0·2 0·65 / 0·85	0·1 0·35 / 0·45	0·3 0·3 / 0·6	0·25 0·15 / 0·4	0·5 0 / 0·5
,, 1 ,, ..	0·2 0·65 / 0·75	0·1 0·35 / 0·45	0·3 0·3 / 0·6	0·25 0·15 / 0·4	0·5 0 / 0·5

Remarks.—Note type of titration with increasing amounts of ammonia. Best germicidal range from ¼ to 1 NH_3 to 1 Cl_2.

Series K.—Stability.

Experiment 1. *Trial of Stability.*—Cl_2 dose 1 p.p.m. for 11-gallon tanks given contact with NH_3 in various ways in dark room.

A.—Contact in 2-litre flask, dose Cl_2 into ammonized water; wait for five minutes, mix; leave for five minutes, pour into tanks.

B.—As above, but mix at once and pour. No five minutes' interval.

C.—Pouring technique as in water-cart.

	A	B	C
¼ hour ..	$\frac{0·25 \quad 0·4}{0·65}$	$\frac{0·6 \quad 0·25}{0·85}$	$\frac{0·35 \quad 0·45}{0·8}$
2 hours ..	$\frac{0·25 \quad 0·35}{0·6}$	$\frac{0·7 \quad 0·1}{0·8}$	$\frac{0·35 \quad 0·45}{0·8}$
4½ ,, ..	$\frac{0·2 \quad 0·35}{0·55}$	$\frac{0·5 \quad 0·2}{0·7}$	$\frac{0·35 \quad 0·35}{0·7}$
26 ,, ..	$\frac{0·15 \quad 0·2}{0·35}$	$\frac{0·5 \quad 0}{0·5}$	$\frac{0·25 \quad 0·25}{0·5}$
48 ,, ..	$\frac{0·15 \quad 0·15}{0·3}$	$\frac{0·4 \quad 0}{0·5}$	$\frac{0·25 \quad 0·2}{0·5}$
72 ,, ..	$\frac{0·075 \quad 0·05}{0·125}$	$\frac{0·225 \quad 0·2}{0·425}$	$\frac{0·2 \quad 0·05}{0·25}$
96 ,, ..	$\frac{0·1 \quad 0}{0·1}$	$\frac{0·3 \quad 0}{0·3}$	$\frac{0·2 \quad 0·05}{0·25}$
120 ,, ..		$\frac{0·25 \quad 0}{0·25}$	$\frac{0·15 \quad 0}{0·15}$
144 ,, ..		$\frac{0·2 \quad 0}{0·2}$	$\frac{0·05 \quad 0}{0·05}$
168 ,, ..		$\frac{0·15 \quad 0}{0·15}$	$\frac{0·05 \quad 0}{0·05}$
192 ,, ..		$\frac{0·05 \quad 0}{0·05}$	

Remarks.—Note extraordinary stability of first fraction, or second fraction may gradually change to first fraction.

Experiment 2.—*Effect of heat* on mixtures of equivalents of Cl_2 and NH_3 and half an equivalent of NH_3 and one of Cl_2 at tap-water temperature, 5° C. (41° F.) and 21° C. (70° F.).

	5° C.		21° C.	
Ratios by weight ..	(*a*) ¼ $NH_3 + Cl_2$	(*b*) ½ $NH_3 + Cl_2$	(*c*) ¼ $NH_3 + Cl_2$	(*d*) ½ $NH_3 + Cl_2$
Titration, 10 c.c. of mixture in 250 c.c. tap-water	$\frac{0·1 \quad 0·7}{0·8}$	$\frac{0·5 \quad 0·2}{0·7}$	$\frac{0·1 \quad 0·5}{0·6}$	$\frac{0·5 \quad 0·3}{0·8}$

25 c.c. extracted with 25 c.c. CCl_4 and placed in 300 c.c. tap-water for titration.

(*a*) (1) Water residue	(*a*) (2) CCl_4	(*b*) (1) Water residue	(*b*) (2) CCl_4	(*c*) (1) Water residue	(*c*) (2) CCl_4	(*d*) (1) Water residue	(*a*) (2) CCl_4
0·2 1·1	0 0·7	$\frac{0·9 \quad 0·3}{1·2}$	$\frac{0 \quad 0·3}{0·3}$	0·2 0·9	0 0·6	1·3 0·2	0 0·3
2·0		1·5		1·7		1·8	

Effect of Heat.—A titration of 10 c.c. from each flask in 250 c.c. of water at each 10° rise of temperature. Cf. above titrations.

	¼ $NH_3 + Cl_2$	Cl_2 21° C.	½ $NH_3 + Cl_2$
38° C.	$\frac{0 \quad 0·6}{0.6}$		$\frac{0·3 \quad 0·4}{0·7}$
50° C.	$\frac{0 \quad 0·6}{0·6}$		$\frac{0·3 \quad 0·4}{0·7}$
60° C.	$\frac{0 \quad 0·6}{0·6}$		$\frac{0·3 \quad 0·3}{0·6}$
70° C.	$\frac{0 \quad 0·6}{0·6}$		$\frac{0·5 \quad 0·2}{0·7}$
90° C.	$\frac{0 \quad 0·5}{0·5}$		$\frac{0·4 \quad 0·2}{0·6}$
96° C.	$\frac{0 \quad 0·4}{0·4}$		$\frac{0·3 \quad 0·3}{0·6}$

Remarks.—Mixture of equivalents appears more stable. Note character of the titrations.

Series L.

Experiment 1.—Experiment with a view to examining titrations and working out combining ratios of Cl_2 and NH_3. Contact of 11-gallon tank dose, 1 p.p.m. in 2-litre flasks.

Evidence seems to point to the fact that two combinations exist—one of equivalents of Cl_2 and NH_3, and one of an equivalent of NH_3 with 2 of Cl_2.

	Cl_2 $\frac{1}{10}$ NH_3 by weight		Cl_2 $\frac{1}{4}$ NH_3 by weight	
	Cl_2 dosed into ammonized water in flask—leave for 15 minutes.			
Titration of liquor without water 50 c.c.	2·1	1	1·4	1·1
	3·1*		2·5	
50 c.c. dosed into 200 c.c. H_2O ..	1·2	1·6	1·1	1·5
	2·8		2·6	
50 c.c. dosed into 400 c.c. H_2O ..	0·8	1·7†	0·8	1·5
	2·5		2·3	
Dilute with water to give 1 p.p.m. equivalent dose and titrate 355 c.c. against N/100 thiosulphate	0	0·4	0·2	0·4
	0·4		0·6	

* 3·1 = a possible 0·044 grm. of Cl present out of 0·05.

† 1·7 = a possible 0·0237 grm. of Cl present out of 0·05 = 49 per cent.

One-tenth NH_3 titration figures show a gradually decreasing available chlorine figure due to absorption of free chlorine by water, and the only fraction left is the second one. In the case of $\frac{1}{4}$ NH_3 titration, two fractions have been produced.

On calculation it appears that 0·0237 Cl_2 has combined with 0·005 NH_3 = a combining ratio of practically 4 Cl_2 to 1 NH_3 by weight, or two equivalents of Cl_2 and one of NH_3.

Experiment 2.—Ranging experiments indicating optimum concentrations for general working purposes. Contact of $\frac{1}{10}$ water-cart dose or ratios of Cl_2 = 0·05 grm. to 0·025 NH_3 in 2-litre flasks in increasing concentration. Ratios by weight given—after mixing and contact 20 c.c. from each flask titrated in 500 c.c. tap-water.

A		B		C		D		E		F		G	
1 Cl_2		2 Cl_2		3 Cl_2		4 Cl_2		5 Cl_2		6 Cl_2		8 Cl_2	
0·5 NH_3		1 NH_3		1·5 NH_3		2 NH_3		2·5 NH_3		3 NH_3		4 NH_3	
0·2	0·3	0·45	0·15	0·6	0·5	0·7	1·1	0·7	1·2	0·7	1·7	1	1
0·5		0·6		1·1		1·8		1·9		2·4		2	

Remarks.—(A) Gives best return; (G) gassing freely, evolution of N_2. Experiment done in intense sunlight should be repeated.

Experiment 3.—As in 2 above, in two litres of water and kept in the dark.

Chlorine ratios by weight..	0·5		1		2		4		8*	
NH_3 ratios	0·25		0·5		0·1		2		4	
20 c.c. titration in 500 c.c.	0·475	0·025	0·9	0·2	1·2	0·8	2	0·7	1·9	4
tap-water	0·5		1·1		2		2·7		4·9	
Amount of Cl_2 added ..	0·025 grm.		0·05 grm.		0·1 grm.		0·2 grm.		0·4 grm.	
Available	0·01775		0·03908		0·0710		0·09585		0·17395	
=	71 %		78 %		71 %		48 %		43 %	

* Gassing freely, N_2 evolved.

Remarks.—Best result in 2 litres with 0·05 grm. Cl_2 and an equivalent of NH_3.

Experiment 4.—Ranging down, using slightly higher concentrations of Cl_2 (= 0·0625), and using ratios of $Cl_2 : NH_3 :: 4 : 1$.

Vessels containing one to eight litres of water were dosed with ½ an equivalent of NH_3, into which was dosed after mixing an equivalent of Cl_2 = 0·062. Appropriate quantities were taken and made up to 200 c.c. with tap-water. Time of contact, five minutes before mixing Cl_2, and five minutes afterwards.

Litres:	1	2	4	6	8
Amount titrated made up	25	50	100	150	200
to 200 c.c with tap-water	0·5 2·7	1 3.3	1·2 2·7	1·8 2·2	2·2 1·5
	3·2	4·3	4	4	3·7

Ideal concentration = 0·06106 in 2,000 c.c. out of a possible 0·0625.
= a loss about 0·01. Content = 31·25 p.p.m.

Experiment 5.—Repeat ranging up with equivalents of $\frac{1}{10}$ water-cart dose = 0·05 Cl_2 in larger containers. Ratios used = 1 of Cl_2 + ½ NH_3 by weight.

Litres of water:	1	2	4	8
Appropriate amounts titrated	50 c.c.	100 c.c.	200 c.c.	400 c.c.
and made up to 400 c.c.	2·5 2·3	3 3·3	3 3·3	2·7 4·2
with tap-water	4·8	6·3*	6·3	6·9†

* = Loss of 0·005 grm. Cl_2.
† = ,, 0·001 ,, ,,

Experiment 6.—Ranging to find optimum concentration for an equivalent of Cl_2 with ½ an equivalent of NH_3. All in two litres of water—ammonia added first and well mixed, weight of Cl_2 equivalent = 0·05 grm.

	A	B	C	D	E	F
Cl_2	1	2	3	4	6	8
NH_3	0·25	0·5	0·75	1	1·5	2
20 c.c. titrated in	0 1·5	0·5 1·7	1·2 1·3	1·8 1·6	3·8 1·9	5 2·2
300 c.c. tap-water	1·5	2·1	2·5	3·4	5·7	7·2

Remarks.—

(A) added 0·05 Cl_2, titration total = 0·053 Cl_2, and is the best.
(B) shows titration loss = 0·9 of a c.c. of N/100 thiosulphate solution.
(C) ,, ,, = 2·0 ,, ,, ,, ,,
(D) ,, ,, = 2·6 ,, ,, ,, ,,
(E) ,, ,, = 3·3 ,, ,, ,, ,,
(F) ,, ,, = 4·8 ,, ,, ,, ,,

Again ideal concentration 0·05 in two litres.

Series M.

It appears that the character of the titration figures are correlated with definite combining ratios of Cl_2 and NH_3, and these can also be affected to a limited extent by methods of mixing.

(1) Three series of 2-litre flasks containing half an equivalent, an equivalent and two equivalents of NH_3, and well mixed. To each was added one equivalent of Cl_2 = 0·05 grm., and different methods of mixing adopted: 25 c.c. titrated in 500 c.c. water—all flasks kept in dark.

A = mix chlorine at once and dose.
B = allow Cl_2 5 min. contact, mix; another 5 min. contact, dose.
C = „ 15 „ „ „ „ 15 „ „ „

Relative amounts of NH_3 by weight	¼	½	1	*Remarks.*
A. Titrations ..	$\frac{0{\cdot}7 \quad 1{\cdot}1}{1{\cdot}8}$	$\frac{1{\cdot}3 \quad 0{\cdot}3}{1{\cdot}6}$	$\frac{1 \quad 0{\cdot}3}{1{\cdot}3}$	Note relatively large second titration fractions with lower ratios of NH_3 and large first fraction with higher.
25 c.c. in water after ¼ hour	$\frac{0{\cdot}6 \quad 1{\cdot}2}{1{\cdot}8}$	$\frac{1{\cdot}3 \quad 0{\cdot}25}{1{\cdot}55}$	$\frac{1 \quad 0{\cdot}3}{1{\cdot}3}$	
B.	$\frac{0{\cdot}4 \quad 1{\cdot}1}{1{\cdot}5}$	$\frac{0{\cdot}9 \quad 0{\cdot}6}{1{\cdot}5}$	$\frac{0{\cdot}7 \quad 0{\cdot}2}{0{\cdot}9}$	As above but longer contact of Cl_2 solution without perfect mixing — relative excess of Cl_2, in places giving a larger second fraction.
C.	$\frac{0{\cdot}5 \quad 1{\cdot}1}{1{\cdot}6}$	$\frac{0{\cdot}9 \quad 0{\cdot}7}{1{\cdot}6}$	$\frac{0{\cdot}8 \quad 0{\cdot}2}{1}$	As above, but on the whole the use of a double equivalent of NH_3 unless rapidly mixed results in greater loss of available Cl_2.

(2) Experiment with half an equivalent and one equivalent of NH_3 and one equivalent of Cl_2. Mix at once after dosing, leave for ½ hour on bench in the dark—titration 20 c.c. of mixture in 500 c.c. tap-water.

Cl_2 = 0·05 grm. per flask.

Relative amount of NH_3 by weight	½	¼	*Remarks*
Titration =	$\frac{1 \quad 0{\cdot}4}{1{\cdot}4}$	$\frac{0 \quad 1{\cdot}4}{1{\cdot}4}$	Typical titration figures = 0·0497 grm. of Cl_2 out of 0·05 added.

A further equivalent of Cl_2 added to the flask containing equivalents of NH_3 and Cl_2. Mix at once and leave for ½ hour.

Titration = $\frac{0{\cdot}4 \quad 1{\cdot}8}{2{\cdot}2}$ *Remarks.*—An increased first or free chlorine fraction might be expected, but it is reduced and a larger second titration fraction is obtained.

Addition of a third equivalent of Cl_2 to same flask. Mix at once and leave for ½ hour.

Titration = $\frac{1{\cdot}7 \quad 1{\cdot}3}{3{\cdot}0}$ *Remarks.*—The optimum combining ratio for second fraction has been exceeded, hence increase on the free side, i.e., first fraction. Loss is due to exposure of free Cl_2.

After ¾ hour on bench $\frac{1{\cdot}3 \quad 1{\cdot}3}{2{\cdot}6}$ Further loss of free Cl_2 owing to exposure on bench.

(3) Experiment demonstrated to Mr. Race. Mixtures left on bench for 2½ hours. Same method as above, using flasks containing :—

An equivalent = 0·05 grm. poured into 11-gallon tanks giving dosage of 1 p.p.m,	Cl_2 1 p.p.m.	Cl_2 1 + ⅛ NH_3	Cl_2 1 + ¼ NH_3	Cl_2 1 + ½ NH_3	*Remarks.*
Titration of 355 c.c. N/100	$\frac{0.4 \quad 0}{0{\cdot}4}$	$\frac{0{\cdot}1 \quad 0{\cdot}4}{0{\cdot}5}$	$\frac{0{\cdot}2 \quad 0{\cdot}7}{0{\cdot}9}$	$\frac{0{\cdot}8 \quad 0{\cdot}0}{0{\cdot}8}$	With Cl_2 0·6 has been absorbed by water. Using ratios ⅛ NH_3 0·5 has been absorbed being uncombined. With ¼ a typical second fraction titration, little absorption; with ½, a typical first fraction titration.

One flask dosed with equivalents of Cl_2 (0·05) and NH_3 (0·025).

20 c.c. in 500 tap-water = 1 p.p.m. Titration = $\dfrac{1 \qquad 0{\cdot}2}{1{\cdot}2}$ Typical titration.

A second equivalent of Cl_2 added and mixed at once.

20 c.c. titrated in 500 tap-water now = $\dfrac{0 \qquad 2{\cdot}5}{2{\cdot}5}$ Note change of type of titration.

(4) Demonstration to Dr. Higgins and Mr. Magrath.

As above	Cl_2 alone	$Cl_2 + \frac{1}{4} NH_3$	$Cl_2 + \frac{1}{2} NH_3$
20 c.c. titrated in 500 of tap-water..	$\dfrac{0{\cdot}3 \qquad 0}{0{\cdot}3}$	$\dfrac{0{\cdot}1 \qquad 0{\cdot}6}{0{\cdot}7}$	$\dfrac{0{\cdot}6 \qquad 0{\cdot}1}{0{\cdot}7}$

	$Cl_2 + \frac{1}{2} NH_3$	
20 c.c. titrated in 500 of tap-water ..	$\dfrac{0{\cdot}9 \qquad 0{\cdot}2}{1{\cdot}1}$	Typical titration of combining equivalents.
Added another equivalent of Cl_2 ..	$\dfrac{0{\cdot}2 \qquad 2{\cdot}1}{2{\cdot}3}$	Typical titration of combination of one equivalent of NH_3 with two of Cl_2.

(5) As above, with varying volumes of water. Combining quantity 1 Cl_2 = 0·05 grm.

	A	B	C	D
	2 litres Mix at once $\frac{1}{4} NH_3$ $\frac{1}{2} Cl_2$	2 litres Mix at once $\frac{1}{2} NH_3$ 1 Cl_2	1 litre Leave 5 mins. before mixing $\frac{1}{4} NH_3$ $\frac{1}{2} Cl_2$	1 litre 5 mins., mix 5 mins. $\frac{1}{4} NH_3$ 1 Cl_2
20 c cc. titrated in 500 c.c. water	$\dfrac{0{\cdot}6 \qquad 0{\cdot}05}{0{\cdot}65}$	$\dfrac{0{\cdot}9 \qquad 0{\cdot}2}{1{\cdot}1}$	$\dfrac{0{\cdot}35 \qquad 0{\cdot}35}{0{\cdot}7}$	$\dfrac{0{\cdot}7 \qquad 1{\cdot}1}{1{\cdot}8}$

Remarks.—Rapid mixing with equivalents results in excess of first fraction and little second.

	Add $\frac{1}{2}$ part Cl_2 to A	Add 1 part Cl_2 to B	Add D to 1 litre water containing $\frac{1}{4} NH_3$
20 c.c. ..	$\dfrac{0{\cdot}5 \qquad 0{\cdot}6}{1{\cdot}1}$	$\dfrac{0{\cdot}7 \qquad 1{\cdot}3}{2{\cdot}0}$	$\dfrac{0{\cdot}3 \qquad 0{\cdot}1}{0{\cdot}4}$

Remarks.—Although you may change up one combination to the other, you cannot change them back by dosing into NH_3 solution. Hence the change can only be effected in one direction.

(*To be continued.*)

A FURTHER COMMUNICATION ON THE TREATMENT OF GONORRHŒA BY KATAPHORESIS.[1]

By Major A. T. FROST,
Royal Army Medical Corps.
Royal Herbert Hospital, Woolwich.

In November, 1923, I reported to this Section the trend of a line of research on a new arm in medicine in the treatment of gonorrhœa, by making use of the pressure of an electric current to bring the gonococci when deep in the tissues within the sphere of action of colloidal antiseptics, in contradistinction to the use of the rate of flow of a current of electricity to convey chemical antiseptics to the tissues.

The preliminary results of this new method of treatment, known as kataphoresis, were encouraging and were sufficiently definite to bring before you. At the first report some hundred cases were in hospital for an average of thirty days when treated by a negatively charged colloidal silver made electrically. It was anticipated that chemically prepared colloidal silver would act as well as the electrically made colloid. This expectation has been verified during the past year.

As practically no literature exists dealing with the use of kataphoresis in medicine a difficult and unlighted path has been travelled during the course of work of the past year. Many side-tracks were traversed, but these only led us into further darkness.

Gradually the period spent by patients under treatment for gonorrhœa in hospital increased till the time in hospital approached fifty days for the average case.

It was only in September of last year (1924) that the advice given by Sir William Leishman [2] at the meeting of this Section in November, 1923, could be carried out effectively. He advised the use of the microscope to elucidate the action of the treatment on the tissue cells and organisms. And we who have been working at the subject beg to acknowledge that any light which has come to us has been through following that advice.

The only change in the treatment up to the end of the year 1923 was the substitution of chemically made for electrically made silver colloid. In April, 1924, it was noted that the number of closed urethral follicles was

[1] Paper read at Meeting of the War Section, Royal Society of Medicine, February 9, 1925, and published in the *Proceedings* of the Society.

Since reading the above paper it has been found that macrophages are much increased in the pus from the urethra after toxin kataphoresis. The macrophage can be seen engulfing injured leucocytes with their contained gonococci, which are also in various stages of disintegration within the macrophage.

more marked in those cases treated by kataphoresis than in cases in which this method of treatment had not been used. This condition was due to the use of a negatively charged colloid in contact with tissues which are themselves negatively charged; and by the driving of gonococci more deeply into the urethral mucous membrane increased exudation and reaction in the follicles were set up. This resulted from the necessary experimental variations of treatment which it was thought might improve the treatment. The colloid was changed by giving it a positive instead of a negative charge, so that the electric pressure would act towards the lumen of the urethra instead of driving organisms deeper into the tissues. This appeared to have been the means of reducing the number of closed follicles, but did not reduce the stay in hospital. At the same time an attempt was made to reduce the number of applications and also to diminish the time during which the colloid under electric pressure was applied to the urethra.

The method adopted by the middle of September, 1924, was that of applying a positive colloid for twenty minutes and of repeating it on four successive days. The results were not good. At this point a series of patients was taken, and during the treatment the movement of the colloid which was being applied to the patient was watched under dark-ground illumination, under exactly similar electrical conditions. As the current acted on the colloidal silver it was soon seen that the action was not a simple one, but the resultant of a combination of physical and electrical phenomena.

One of the earliest of these phenomena to be noted was a deposit on the end of the positive electrode in the urethral nozzle. This was found to be a mixture of precipitated colloid, pus-cells, and gonococci. Next it was demonstrated that, after a period of time depending on the amount of current and voltage employed, the route of the colloidal particles, which began at the positive pole within the nozzle and progressed towards the tissues of the urethra, as was intended, actually changed its direction, and that the stream of colloidal particles passed from the mucous membrane towards the positive pole and led to a deposit of cells and gonococci on the positive wire above mentioned. By the addition of suitable colloidal indicators, such as phenol red, to the silver colloid, the change in the amount of concentration of H and OH set free in the colloid by the action of the current on the water in which the silver was suspended was accurately measured.

Further information was obtained during the experiments with the use of fifteen per cent gelatine to represent the tissues. The silver colloid was precipitated on the surface or edge of the gelatine at definite concentrations of H and OH-ions in the fluid, and the particles were redispersed at a higher concentration of these ions, following the known physical laws of colloidal chemistry.

These experiments were carried out under dark-ground illumination with gelatine fifteen per cent to represent the urethra in section, and were

done to ascertain whether it was possible to cause the colloidal silver particle to penetrate into the tissues. The results were both interesting and suggestive of the possibilities of this form of treatment, for the silver could be seen first to be deposited on the surface of the gelatine, and then from this deposit a clear layer of undeposited colloid could be seen penetrating for a depth of two millimetres into the gelatine. The conditions as regards the colloid, the time, and the amperage and voltage necessary to bring about these results were carefully noted.

Patients were put under as nearly identical conditions in the circuit as in the experiment under the microscope, and the clinical results were noted. The experiments were carried on till the best results were obtained with the particular method under trial. It was considered that the colloidal metal used was of secondary importance compared with the conditions under which the electric pressure and current were applied, and with the acidity or alkalinity of the fluid in which the colloid was suspended.

The gonococcus was then put under test as to how it reacted under these conditions. It has been noted that a high degree of alkalinity resulted from the passage of the current through the urethra. The gonococci could be seen actually moving to the positive pole, which accounted for the concentration of cells and organisms on the tip of the wire in the urethral nozzle, and gonococci were seen dissolving in the fluid. Further, when the direction of the current was reversed and the movement was directed towards the surface of the gelatine, the organisms could be traced to the surface of the gelatine. Similarly the pus-cells became swollen and lysed with their contained gonococci. The leucocytes became twice or treble their original size before breaking up, their polymorphic nuclei changing into a round or oval contracted mass at the same time.

Owing to the brief time at disposal I propose to omit any record of the experimental work and confirmatory tests of the observed phenomena, also any detailed account of the stages which led up to our present position with regard to kataphoresis; but it is of interest to show some of the actual slides made during the early stages of the inquiry, which formed the basis upon which the further work developed.

The last point in the scheme laid out for investigation in 1923 was whether immunity could be obtained during the disease by adding the toxins of the gonococcus to the colloid in the hope of getting them conveyed into the tissues when adsorbed to the colloid. In the gelatine experiments solutions of the gonococcus protein were definitely seen to penetrate and become precipitated by the oppositely charged ions in the substance of the gelatine. For a year it had been the custom of Major Lambkin, the officer in charge of the treatment of gonorrhœa at the Royal Herbert Hospital, Woolwich, to use a solution of gonococci in distilled water —250,000,000 in each cubic centimetre—as a provocative test of cure. He finds that this method is the most active test, much more reliable than the injection of irritating chemicals such as silver nitrate or magnesium chloride.

At the laboratory various strengths of the proteins obtained from the gonococcus were used to protect the colloid, and also various fractions of the protein were used in an attempt to find one with the least toxic and highest immunity value. The first protein used was the endotoxin, ranging in strength from 30,000,000 to 160,000,000 organisms per cubic centimetre. This was excellent when used electrically as a provocative of pus and gonococci in an uncured case which had become dry. Other fractions tried were the alkali soluble fraction, the alcohol insoluble fraction, the mixture of the alkali soluble fractions of the *Gonococcus*, *Staphylococcus*, and of *Bacillus coli*, the two latter being added owing to the poor antigenic value of the gonococcus alone.

An increase of infiltration of the urethra was noted at this period (December, 1924, to January, 1925). This could be directly attributed to the introduction of the toxin into the urethra during the acute stage of the disease. There was also seen an increase in the number of cases suffering from posterior urethritis and epididymitis.

The method of application of the colloid and of the colloid protected with toxin was reviewed, and the whole method investigated with the aid of charts made for each case, showing the dose of toxin, type of toxin, time of application, and strength and pressure of the current used. These charts showed that those cases which received the weaker dose of toxin, and had a shorter time of application, did much better than those undergoing more active and stronger applications. The urethral infiltrations and closed follicles practically ceased, and the urethra began to look normal after a few applications of the colloidal silver.

At the time of writing this paper the method in use is first to wash out the urethra with lime water of a strength of 0·2 per cent, and afterwards to remove the salts with distilled water. Next the bladder is filled with silver colloid of a strength of 1 in 32,000 silver, with N/300 NaOH added, equal to 0·13 gramme of NaOH per litre of colloid. Then the patient sits on a pad of copper gauze well wrapped in lint, the pad fitting into the hollow of the perineum, and the penis is bandaged up to the tip with a one-inch bandage, which is then soaked in water. The negative pole is attached to the perineal pad by soldering the wire to the copper gauze. The positive pole is led into the colloid by means of a wire which ends just at the tip of the special flanged nozzle which carries the colloid to the urethra. Means are adopted in the circuit to vary polarity when required.

The colloid itself in the glass funnel consists of a 1 in 32,000 silver colloid, chemically made by means of placing in a litre measure eighty cubic centimetres of a one per cent solution of silver nitrate, and adding N/1 ammonia solution until just a faint haze is left. The litre is made up with triply distilled water. Another litre measure is filled with triply distilled water to which 100 cubic centimetres of tannic acid are added of a strength of 1·3 gramme to the litre. The two are mixed with constant rotation of the bottles used. The colloid is made positive by means of positively

charged H-ions—many methods of effecting this without precipitation of the colloid are available. Lastly, a small quantity of gonococcal endotoxin of an equivalent strength of half a million organisms per cubic centimetre is added to the colloid.

The patient (whom we have left seated on the negative pad with his bladder filled with negative colloid) now inserts the nozzle into his meatus, and when his urethra is full of colloid, the current at a pressure of 112 volts is turned on in the main circuit including the potentiometer.

An accessory resistance of Eureka wire is inserted in a lamp socket so that the potential drop of the main circuit is 112 volts, made up of a potential drop of 12 volts in the lamp socket resistance and 100 volts in the potentiometer.

By means of the sliding contact of the potentiometer the pressure is slowly increased in the patient's circuit from zero to 100 volts and allowed to act for ten minutes. The current is then reversed and the direction of the colloid particles for the next ten minutes is from the inside of the urethra towards the pad, through the tissues, carrying in colloid and endotoxin. In the first instance, for the first ten minutes, the negatively charged gonococci are attracted out of the tissues into the lumen of the urethra, and, as has been mentioned, can be recovered from the tip of the positive wire inside the nozzle.

This process is repeated for two or three days, and if successful the case dries up and the treatment is not repeated unless failure to clear up the case is indicated by continuance of gonococci in daily smears from the urethra. When the patient is reported as having a dry urethra for five or six days, the next stage of the treatment is in the form of a test of cure. If the urethroscopic examination of the urethra shows it to be clear of inflammation, and the vesicles and prostate are found normal, and if the case is clear for six days after what is really producing a negative phase in the urethra—namely, the injection of endotoxin-protected colloid electrically applied—the case is declared cured. This test is carried out as follows: The preliminary preparation is the same as before, and the kataphoresis stage comes next. Then a small ten-cubic-centimetre funnel, with a similar electrical attachment to that used in kataphoresis, is filled with endotoxin-protected colloid, each cubic centimetre of which contains the equivalent of twenty or thirty million gonococci. This is introduced into the urethra by means of the special flanged nozzle, and the current slowly applied. The amperage and voltage and the strength of endotoxin-protected colloid must be watched and not exceeded, otherwise too big a reaction may occur, especially if the case is not cured. If the case is cured no reaction occurs. The amperage should not exceed three-fifths of a milliampere; the voltage should be kept below twenty. The time of application which is found to be best is one and a half minutes, as application for a longer time than this is liable to produce more reaction and infiltration in uncured cases, and delay in final cure.

The foregoing record is a brief account of the position of this research up to the present date.

Owing to the numerous factors involved in this work, and the difficulty of judging by immediate observation on a few cases the effects of small changes in the method of application—for example, the difference of half a minute in applying the test of cure—it may take years of work to obtain what is essential, a fixed method of treatment. The basal fact with regard to the method consists in a definite control of the disease being possible in so far that gonococci can be taken out of the tissues and ducts of the urethra; that the protein of the gonococcus can be driven into the tissues, and probably, by analogy, deposited within the tissues as a precipitate.

In discussing the results, it must be emphasized that disease external to the urethral canal is at present outside the scope of kataphoresis. It is only in the acute cases and in those in which the patients suffer from chronic anterior urethritis that hope of success is predicted. The figures might be divided into three groups for comparison. The first group comprises 107 cases treated without any knowledge of the principles which govern kataphoresis, with an average time of thirty days in hospital, reported to this Section in November, 1923. The results were good. But the conditions under which the colloid was made were constantly changing, and the resulting colloid was variable in strength and in size of colloidal particle. It also tended to produce chronic folliculitis towards the beginning of the second period, and therefore it was abandoned.

The second period, from May to December, 1924, was a period of retrogression owing to the number of cases which failed to clear up under an average of fifty-three days in hospital. This period was one of frequent change of the method of application. The principal method consisted in the use of a positive instead of a negatively charged colloid. It is now recognized that the principal cause of failure was too long application of the current, which has been remedied in the third period. The number of cases treated in the second series was 191.

Since September 30, 156 cases have been treated up to date and the patients were 39·8 days in hospital. The first two months were devoted to experimental work, as has been briefly detailed. Definite lengthening of the period in hospital resulted from using for immunity the strong toxin-protected colloid which is now only used as a test of cure. These cases developed infiltrations which took a long time to clear up, and the method of treatment has not been continued. However, within the last few weeks a modification has been tried by adding the equivalent of 500,000 gonococci per cubic centimetre of silver colloid in the treatment. It was observed by this method, and first noted when using the stronger toxin-protected colloid, that on the fourth to the sixth day after treatment had been given, all pus-cells were degenerated and appeared to be lysed. As the time was too long for any direct action of the treatment, it is suggested that an autolysin is developed in the tissues which is either a

direct or indirect result of the introduction of the toxin by kataphoresis. This is shown by the charts, and is indicated by an interrupted line in the curve of epithelium to pus ratio. During this cell-disintegration no gonococci can be detected, but on the return of gonococci in the pus, the unchanged cells reappear, while in cured cases there is a decline in pus to the stage in which epithelial cells only are found.

The cases under this period were thirty in number, and the patients were in hospital 31·2 days for each case.

This paper is not intended to be a report of a completed method, but a progress report with its findings, brought up to date, showing the possibilities of a new method. There are numerous facts which have yet to be elucidated, and not the least of these is the maximum dose of the various factors. Selected typical examples of the various results obtained are plotted, the charts showing the factors used in the treatment.

It is suggested that the future line of work should consist in fixing the voltage, amperage and time of application at their finest limits; in finding the best type of antigen and its dose, and as part of this latter, in determining a method of growing the gonococcus so that there is a fixed strength of toxin used in this form of treatment, which is of much more importance than in the preparation of vaccines.

Control of the electric supply of direct current has been very little changed since the publication of my previous paper on this subject. The change has consisted in an attempt to render cheaper the means of regulating the current. The direct current of 112 volts is brought on to a board through a plug and a 5-ampere fuse to a switch which allows the current to pass through a resistance which regulates, as described above, the potential drop to exactly 100 volts maximum pressure from which the current passes to the potentiometer and back to the negative pole of the main. From each end of the potentiometer the current is tapped, so that the patient receives a gradient of voltage regulated from zero to 100 volts. A milliameter is in this circuit to show the rate of flow. This is the simplest form of switchboard. It has been working, without giving any trouble, for the past six or eight months. All the wiring is on the front of the board and none at the back, so that there is no difficuity in tracing the circuit. Neither has the method of wiring the room for treatment been altered.

The test of cure by introducing gonotoxin-protected silver colloid electrically into the urethra requires no elaborate apparatus. All that is required is a four-six-cell secondary battery with a milliameter in the circuit, and the small funnel and rubber tubing ending in a nozzle in which there is a wire connexion to the positive pole of the battery. The pad is connected to the negative pole. The current loss is inappreciable, and it is only ten to twelve volts at two-fifths of a milliampere for ninety seconds per case. This, as I have mentioned, only fails in complicated cases with infection of the prostate or vesicles or post-urethra. A vaccine test is combined with the urethral test to limit these failures. The relapses amounted to sixteen

per cent, however, in spite of the tests during the past year, in which an unusually high number of complicated cases occurred. But they should not occur from this onwards.

In conclusion, I wish to acknowledge the careful and very laborious research work of Captain J. Lyn Dimond, by which the biochemical and electrical facts were elucidated and repeatedly confirmed, and form the subject of this paper. Also, I have to thank Major E. C. Lambkin, D.S.O., for his clinical insight and control of all the cases under this form of treatment which kept it from straying too far into wrong paths of inquiry.

Discussion.

Captain F. Carminow Doble, R.A.M.C., asked whether this treatment had been tried in the case of women. Diathermy, the great rival of this new method, had recently had excellent results in the treatment of gonorrhœal infections of the cervix in women and of the prostate in men. He asked whether the amount of penetration of the colloid particles had been worked out by experiment on raw meat, such as a beef-steak.

Squadron-Leader Montgomery said that the treatment and cure of gonorrhœa had always been so unsatisfactory that any new method was much appreciated. In his later results Major Frost had brought down the number of days under treatment to thirty-one. This was a great advance. At the R.A.F. Hospital, Halton, the treatment was that of the old Rochester Row routine method of irrigations by pot. permang., and had resulted in the last thirty-four cases in an average of fifty-five days under treatment. The number of relapses was not as high as twelve per cent. Would the number of relapses (sixteen per cent) in Major Frost's series be accounted for by the fact that the colloid silver failed to penetrate the crypts and follicles or the patches of infiltrated mucous membrane where the infection lurked?

In reply, Major Frost said that he was not impressed by the action of diathermy on the anterior urethra, but that arrangements were under consideration for cases of prostatic and vesicular infection to be treated by diathermy. Relapses were principally due to prostatic and vesicular infections for which no action could be brought to bear by kataphoresis at present.

In the test for cure, using gonococcal antigen, the toxin is obtained by adding distilled water to the organisms. The injection is made into the lumen of the urethra, two or three cubic centimetres, and held in by pressure for twenty minutes. Each cubic centimetre is equivalent to 250 million organisms. This is the method, in use for a year, referred to in the paper.

The question of antiserum had been considered but was not tried owing to the animals available being small. In gonorrhœa the polymorphonuclear cell is looked on with suspicion. It has been noted that pus containing mostly free organisms gives primary cultures more rarely

than pus in which the gonococci are all within the pus cells. Further, the growth is more profuse the longer the pus is rubbed on the surface of the medium. It is thought that the pus-cell has to be broken up to get the organisms in contact with the medium.

Captain J. Lyn Dimond has sent the following additional information :—

The following change has been made in the treatment in order to avoid running into the bladder an alkaline solution which occasionally may pass back into the urethra and cause local burns due to the high conductivity of the alkaline colloid allowing a dangerous amount of current to pass through it into the tissues of the patient. As the alkaline colloid is exactly similar in appearance to the non-conducting colloid used for kataphoresis, there was also a real danger that it might be used for kataphoresis with consequent danger to the patient.

So soon as the patient reaches hospital he is put on a barley water diet and given bicarbonate of soda solution until the pH of his urine reaches 8·0. To control this, the patient's urine has the pH estimated daily and so soon as a pH of 8·0 is reached kataphoretic treatment is applied.

In addition to producing the right chemical and electrical conditions required for satisfactory kataphoresis, there is a definite diminution of pain, congestion and irritation of the local lesions which permit of a much more satisfactory application of kataphoretic methods than in the very acute early stages, when the patient's urine is highly acid and of low pH.

REFERENCES.

[1] *Proc. Roy. Soc. Med.*, 1923-24, xvii (War Section), pp. 1-6.
[2] *Ibid.*, p. 6.

A CORRESPONDENCE CIRCLE.

X.

THE R.A.M.C. ASSOCIATION.

BY MAJOR M. B. H. RITCHIE, D.S.O.
Royal Army Medical Corps.

THERE is a new institution which should appeal to every reader of this Journal who has served in the Royal Corps, and that is the R.A.M.C. Association. It is now in being, but has not received all the support it deserves, as one is apt to agree to it in principle without taking the trouble to join. It is up to each of us to give it our individual support, so that it may speedily flourish and become an active, useful organization, representative of every section of the R.A.M.C., and constituting a strong bond of union between past and present members of all ranks from private to general. Branches are in course of formation in various parts of the country and at stations abroad, but they will not thrive until we join up in greater numbers than hitherto.

The need for an Association is apparent. Nearly every unit of the British Army already possesses one, and it is unlike us to be behind in this respect. There is a fine spirit of friendliness and helpfulness in the Corps, and we should endeavour now to link up the interests of past members with those of serving members. The high standard of general and technical education in the warrant and non-commissioned ranks, and the good type of man who has served in the Corps, have resulted in many old comrades "making good" in civil life. This should help towards building up the Association, and perhaps improving the conditions of others who have not been so fortunate. The comradeships formed in the Army in peace and war, at home and abroad, must be preserved. Our history goes back a long way before 1914, and is still in the making; for ours is not only the comradeship of the Great War, but the comradeship of a great Corps.

Among other beneficial purposes that form the objectives of the Association is the fostering of *esprit de corps*. In the R.A.M.C. we have a particularly strong and virile brand of *esprit de corps*, far more intense than the casual observer would suppose. There is one special feature of service in the R.A.M.C. that requires to be brought into more prominence, and that is the number of soldier families which the Corps possesses. Here is a practical illustration of *esprit de corps* that deserves attention. Members of these families have served King and country in our ranks for two or more generations, and it is possible that we have, for our numbers, as many hereditary soldiers as any other regiment or corps in

the British Army. Whether we hold the record or not, this is an asset of importance that reflects much credit upon the R.A.M.C. and demonstrates the advantages of fostering our *esprit de corps*. Let us hope that the Association will one day compile a list of our hereditary soldier families, as we should know all about them.

There is another point that deserves to be brought to notice also, and that is the way in which the medical service (and the profession) is linked up with fighting units. The profession of medicine and the profession of arms, diametrically opposed in some ways, curiously allied in others, have been associated together very closely. For medical men in the Services and outside have put their sons into fighting units, and so have contributed largely to the recruitment of officers, before the war and after. Indeed, it is possible that fathers or grandfathers of officers include medical men to a greater extent than members of any other profession. Scarcely a family of doctors has no soldier member; scarcely a family of soldiers is without a representative in the medical profession. During last century, when the possession of a private income was next to essential in the commissioned ranks of regiments, younger sons of soldier families entered the medical profession as one in which they could maintain themselves, in the Services or in practice, and they in turn put their sons into regiments of the British and Indian armies. Medicine and fighting go hand in hand; they have done so for some time, *but the grip has now tightened.*

For the soldier wants the doctor, not only to treat the casualties of war, but to assist in winning battles. In the old days our scope in war was limited to the treatment of casualties, and our work was humanitarian. The military value of the R.A.M.C. is only now beginning to be understood. We hold immense possibilities, as we are the agency that can assure one of the dominating factors of success in war—the conservation of a Nation's fighting man-power. Let there be no mistake about our scope in a future struggle; should the Empire be again involved in a fight for existence, we become a factor in the achievement of victory. Our work is now more than humanitarian.

Thus, though our history teems with honourable records that bear comparison with any, our oldest comrades will probably agree that the Spirit of the new Association is concerned as much with our future as with our past. The Corps is in its youth; its scope is expanding and it must look well ahead. Whatever the future may hold for it one point is definite—it goes forward to assume increased responsibilities in the service of the Empire if again involved in war. It is this knowledge of our potentialities, of our power to assist the cause of Empire, that should guide us in laying down lines of future development. The present is but a staging-point, a rest by the wayside, from which we may have to move forward into the unknown. An active R.A.M.C. Association can help here. We require a close *liaison* between the past and the present, in order to develop our future.

Membership of the Association might contribute towards bringing about another desirable object, that of keeping the younger retired officers in touch with their comrades still on the active list. In these days many retire young, and soon lose touch. Yet whatever the reasons for retirement may have been, there is not one but has left intimate friends behind. It seems that these friendships are not kept up, and this is apparently borne out by the published list of officers present at the last annual dinner. Of twenty general officers present, no less than fifteen were on the retired list, but the number of retired officers diminished rapidly in the ranks below general, so that among fifty-two majors there were but four retired officers, while twenty-nine captains present were all on the active list. The causes of losing touch should be examined, as they are bound up with the well-being and prosperity of the Corps. They are more important than they seem.

The existence, then, of the Association is an asset to the Corps, and so to the Army. It can further the interests of every officer and man who has worn our badge, and knit them together in a brotherhood which will co-operate intelligently towards developing the future of a service that is as indispensable to an army as artillery. But the Association needs support. *It cannot exist on air.* Its merits must be brought to the notice of all ranks now serving, and kept before them. Let us aim at a hundred per cent membership among officers on the active list. When the officers join up, the men will not lag behind.

In less than a quarter of a century the R.A.M.C. has risen from the status of a secondary service to one of prime importance to the British Army when engaged in war. In our progress we have amassed records of heroism, of devotion to duty, and of steadfast efficiency in war and peace. We stand now a great Corps, with high traditions to maintain, and with a future to develop. Compared with our work in war, that in peace is limited. But we must not think of ourselves solely as we are at the moment—the present is a short page in the history of the Corps, and to grasp the full significance of our ideals and objectives we must look at the Corps from its foundation onward and view its splendid work for the Army in the wars of the Empire. *We have become great, and our minds must expand accordingly.* Much we must remember, much we should perhaps forget; but in the ups and downs of these times that we live in we require to develop clear vision and clear thinking. Let us see ourselves members of a virile Corps with a great function in war; let us think of our *rôle* in the future. We must have an institution like the new R.A.M.C. Association; it is imperative. And the Association needs to be energized by the inclusion in its membership of every individual now serving his country in this Royal Corps to which we all have the honour to belong.

Out-Patient Treatment in the Army.

The great majority of cases receiving medical attention in the Army are treated as "out-patients" for varying periods of time. We have, at

present, no satisfactory means of keeping a permanent record of such cases and at the same time giving immediate information as to a man's medical out-patient history. The only official source is the A and D book kept for "Men treated in Barracks."

On transfer to another station the medical authorities have no record to refer to, such as they have in the case of admissions to hospital (A.F.B. 178) and therefore it will be some considerable time before they get to know those men who are chronic attendants at the morning sick parade.

My plea is for an Official Out-Patient Index Card for every man reporting sick; these could be kept by units in alphabetical order of names.

Every attendance at the M. I. Room would be entered up with the eventual disposal of the case. When any man leaves the station, his Index Card would be forwarded to the M. O. i/c effective troops for retention. In this way a complete medical history is at once available for every man up to the time he leaves the Army.

Such a system is easy to work and from the information given any returns showing the number of days under treatment can be at once compiled. We have such a card for the Dental condition of the soldier; why not for the Medical as well?

The writer has used the system in one station for his own information, but to get the full benefit it must have official sanction and be in use in every station.

The use of such a card could, if desired, be extended to officers and military families.

A suggested pro-forma is attached.

MEDICAL OUT-PATIENT INDEX CARD.

Unit.............. No........... Rank.......... Name................

Station	Disease	Date On	Sick Off	Disposal	Number of days under treatment	Remarks
Aldershot	Boils	6.3.25	24.3.25	Duty	19	Vaccine
,, ...	Contusion arm (R.)	3.5.25	10.5.25	,,	8	X-ray no fracture
Calcutta	N.Y.D. ? appendix	3.12.25	3.12.25	Hospital	1	See A.F.B 178

Clinical and other Notes.

SOME CASES OF PSYCHOGENETIC PSYCHOSIS.

By Major W. L. WEBSTER.
Royal Army Medical Corps.
Officer-in-Charge "D" Block, Royal Victoria Hospital.

Early acute cases of mental disorder amongst soldiers give rise on all occasions to considerable anxiety and difficulty until such time as they can be placed under proper conditions for their nursing and care. The anxiety and distress are frequently very apparent in the unit to which the patient belongs, and are communicated and transferred to the Medical Authorities immediately responsible. Such early acute cases, who exhibit little if anything in way of premonitory symptoms, may belong to one of the many groups of psychosis, and the differential diagnosis at the time of onset is frequently impossible, nor for that matter desirable or of any value. It is possible, however, that in certain cases much might be done by the Medical Officer who is first brought into contact with such a case, if he were to realize the possibility of the case belonging to the group of psychosis, not frequently described, termed variously "situation," "emotional," or "psychogenetic" psychosis.

This form of psychosis occurs from various causes, usually some painful or irksome experience, and the individual instead of making an efficient adaptation to the situation, retreats from reality and develops psychotic or neurotic symptoms. Such cases have been described among prisoners by Glueck, as a result of stress and confinement, and by French observers, Séglas and others, as a result of an emotional situation.

The high recovery rate of insanity occurring in the Army has always been a matter requiring some explanation, and there can be no doubt that a considerable proportion of the cases met with belong to the group of psychogenetic psychosis, and these tend to recover rapidly upon the removal from the stress which has resulted in the failure of adaptation. This high recovery rate is evident in peace conditions, but was particularly marked in the cases treated during the late war, as the soldiers were called upon to adjust themselves to situations of peculiarly stressful character at that time.

In referring to the high recovery rate amongst mental patients in the Army, it must be recalled that any comparison between the Army "recoveries" and civil "recoveries" is of little real value and is apt to be most misleading, owing to the fact that in the Army any case exhibiting the earliest change in speech or conduct is at once admitted to hospital (where the surroundings and environment tend to recovery, owing to the removal of the stress) at a much earlier period than can be done in civil

life under present conditions. Civilian cases exhibiting the same early symptoms would in many cases be unable to receive appropriate treatment until the psychosis was more developed, and are probably for that reason less amenable to treatment. Probably then the Army recovery rate is high because patients obtain early mental treatment at a stage and in a form which, though very desirable, could not be attempted in civil life on the scale necessary.

The characteristic clinical features in a simple case of this group of psychosis are as follows:—

(1) The reaction of the patient to life is, in a general way, normal before the outbreak of the psychosis.

(2) The illness is directly the result of a difficult and disagreeable situation.

(3) The delusional content, if any, is related to the experience which provoked it.

(4) When the stress is removed the patient makes a rapid recovery.

Case S.—A man, aged 20, no family history of mental disease, service two years. He deserted from the Army after about fourteen months' service; he had become entangled with a married woman who was a thief—as a result he was imprisoned for her theft and was afraid to go back to the Army. He was apprehended one month later and taken back to his unit; he was very ashamed of his imprisonment and afraid his unit would find out; he escaped from the guard-room and ran a long way, being chased all the time; he saw he could not escape and remembers no more. He was captured, began to have very violent fits, and was admitted to hospital, where in the notes forwarded with him it is stated: "At frequent intervals acute attacks of delirium come on, with a continuous grunting noise suggestive of terror." After remaining a week in this condition, it is stated his memory for recent events was absent, he was unable to realize that he was in the Army and could not speak. His parents visited him and he did not recognize them; he denied that he was a soldier and said he had just left school; he had apparently a complete amnesia for the time during which he served as a soldier and deserted.

On admission to "D" Block some few weeks after the onset of his symptoms, he was unable to speak but could write answers to questions. Re-education of his speech mechanism was, however, complete after about an hour's suggestion and encouragement. He was completely vague as to how long he had been in hospital before his admission here. He said he was lost as to who he was, and this worried him very much. His memory since admission to "D" Block is perfect and he has now recovered.

Case E.—A man, aged 22. Service seven weeks.

History of illness.—Sudden onset. He, as stated in his notes, "went wild, upset all the beds in his barrack-room, broke the butt of a rifle, smashed all the plates and pots and broke a window." Required restraint both mechanical and chemical and was removed to the local Union; notes

from there state he had been quiet since admission. He was transferred to "D" Block seven days later. He was very slow and dull on admission, unable to appreciate his surroundings, recent memory absent; he said he saw a vision of his mother often beside him, became very excitable, jumping at the least noise. He told me his home was in a small village, which he had never been out of till he enlisted; he was perplexed and muddled and said, "I can't understand these serjeants and majors and all." He said he was made game of in his unit. After a sympathetic and explanatory talk with him he suddenly sighed and said, "Now I feel a lot better in my head like," and he has remained quite well as a result of the removal of the stress of military environment and the promise that he will be going home very shortly.

Case C.—A man, aged 21. Service two months.

This patient was put up for discharge after enlisting as being a case of feeble-mindedness. The Medical Officer then stated the feeble-mindedness was "not sufficient to cause incapacity in civil life, but detrimental to himself and his comrades in the Service." This is apparently an excellent description of the man at the time, but it was not considered to be a sufficient cause for his rejection, which was not then approved. Shortly after this the patient attempted suicide by cutting his throat, and was admitted to hospital. The notes state he was stupid and morose and worried because he could not do things right in his regiment. The day after his admission to hospital he attempted to strangle himself, and was transferred to "D" Block.

On admission he was slow, dull, anxious and confused, emotional—weeps when talking of his home, wants to go home out of the Army. He complains of voices which constantly worry him, calling him a nickname which he had been called in the barrack-room and which is objectionable to him. Voices saying "Give me some money" (he had often lent money to his comrades and not had it repaid), or "Better off if you were dead," etc., etc. All the hallucinations have reference to his Army life, and recall unpleasant memories. He tells me people are "always on to me and plaguing me." "I haven't dared to strike back." After the first sympathetic examination he had improved considerably, talked more clearly with less delay, and within a week he had completely recovered.

I do not propose to comment at any length on the three cases quoted. The feature common to each case was a situation to which the patients were unable to adapt themselves. The clinical features differed in each patient; the first case showed symptoms of hysterical dissociation; the second of a mild confusion; and the third might easily have been diagnosed as a case of dementia præcox.

These cases happen to have been admitted within a few days of each other and seem to be worthy of record, but in many cases where the symptoms are more pronounced and the recoveries less rapid the differential diagnosis between dementia præcox and a psychogenetic psychosis is a

matter of difficulty, and perhaps, in the period during which the case can be observed here, an impossibility. There appears to be no reason to suppose that life in the Army is the cause of a psychosis; in a person of normal make-up careful examination almost always reveals primary evidence of inadequacy. The cases quoted would, we may reasonably assume, have exhibited neurotic or psychotic symptoms as a reaction to a difficult situation in civil life. It happens, however, that they had not had cause to compete with any such situation until their enlistment, which by chance was sufficient exciting cause for their breakdown.

I would like to stress the fact—in the light of these simple cases—that on the occasion of a mental breakdown we should always search for a cause which may have been instrumental in the production of the psychosis and removal of which may effect a cure.

I am indebted to Dr. H. Devine, Consultant in Mental Diseases to "D" Block, for his helpful criticism and advice.

PREVENTION OF HAY FEVER BY POLLACCINE.

By Captain COLIN WILSON.
Royal Army Medical Corps.

Owing to the number of inquiries from various medical officers and even local practitioners, I venture to think that the following case may be of interest to many who either are sufferers from hay fever, or have to deal with cases of this condition. Captain S., R.A.O.C., aged 31, came to me on or about May 10 and said that he had been subject to severe attacks of hay fever every year since the age of 5, with the exception of the time spent in the desert in Egypt during the war. The attacks always came on in June and lasted about fourteen days. He suffered each time from severe conjunctival irritation and nasal catarrh, and had to retire to bed for three to four days with extreme mental depression. The last three years the attacks having begun on June 7, it was decided to try inoculation of "Pollaccine" (Messrs. Parke, Davis and Co.) on the intensive system in order to try and avoid a similar attack this year. The Hay Fever Reaction Outfit was immediately obtained and the test carried out by the ophthalmic method. Pollen toxin is put up in capillary tubes in dilutions of 5, 15, 50, 150, 1,500 and 5,000 units per cubic centimetre, and each dilution is instilled in the eyes, starting at 5 units right eye, 15 units left eye and so on, and one waits five minutes after each instillation to see if a reaction appears. In the case of Captain S., an intense reaction occurred at 150 units per cubic centimetre, and for twenty minutes he had an attack of hay fever with the local symptoms of irritation of the eyes and sneezing. This reaction gives the guide to dosage of the vaccine, and it was decided that

the best dilution to get was pollaccine 100 units per cubic centimetre in a bottle of 25 c.c., and to start with a dose of 0·2 c.c., working up gradually. The following table gives the date, the amount and result of the inoculations. It will be noted that the volume of the injections became so great that pollaccine containing 500 units per cubic centimetre had to be obtained to keep the injection down to a convenient size.

POLLACCINE 100 UNITS PER CUBIC CENTIMETRE.

Date	Amount	Resulting Reaction
16.5.25	0·2 c.c.	Nil
17.5.25	0·5 ,,	Nil
18.5.25	0·75 ,,	Moderate. Local and general.
From 18th to 23rd		Patient away from station
23.5.25	0·5 ,,	Nil
24.5.25	0·6 ,,	Nil
25.5.25	0·8 ,,	Nil
26.5.25	0·1 ,,	Nil
27.5.25	1·2 ,,	Nil
28.5.25	1·5 ,,	Nil
29.5.25	2·0 ,,	Nil
30.5.25	2·5 ,,	Mild local reaction
31.5.25	2·5 ,,	Very mild local and ? general
1.6.25	2·0 ,,	Nil
2.6.25	3·5 ,,	Moderate. Slight local
3.6.25	4·5 ,,	General. Malaise. Had to lie down. No local signs

POLLACCINE 500 UNITS PER CUBIC CENTIMETRE.

4.6.25	0·5 c.c.	Nil
5.6.25	0·75 ,,	Nil
6.6.25	1·0 ,,	Nil
7.6.25	1·5 ,,	Nil. Expected date of attack
8.6.25	2·0 ,,	Slight nasal catarrh. Worked in hayfield 2½ hours
9.6.25	1·0 ,,	Nil
10.6.25	1·5 ,,	Nil. Five hours in a hayfield
11.6.25	2·0 ,,	Nil

Since June 11 to present date patient has had absolutely no sign of hay fever. He has been very fit and states that the slight inconvenience of the treatment is as nothing compared to the miseries he suffers during an attack of hay fever. The cost was £2 16s., and that was also negligible compared to fees he has paid to consultants to try and avoid attacks, with no success whatever, in spite of most treatments recommended having been tried, including various operations on his nose. Next winter inoculations will be started in December or January and be given at intervals of ten days, working up to the maximum dose recommended, i.e., 2 c.c. of 500 units per cubic centimetre, by the beginning of June.

TWO CASES OF GAS GANGRENE.

BY MAJOR G. G. TABUTEAU, D.S.O.
Royal Army Medical Corps.

THE extreme rarity of the above condition in peace time appears to merit the publishing of these two cases. I may say that they are the first that have come under my notice in twenty years, not counting those seen in the Great War, especially on the Western Front, where this appalling condition was a veritable nightmare to the surgeon.

I can find no record of this condition having occurred amongst the wounded in the late Afghan War, but I have been told that it was relatively common amongst the wounded in the Moplah Rebellion (Southern India) in 1922. This may only be a coincidence, but is in accordance with our preconceived ideas as to the ætiology, namely, that it is a disease of warmth and moisture more than cold climates. Both the cases under report occurred in the Punjab, Rawalpindi District, during the early hot weather.

Case 1.—Gunner C., while out shooting with two of his comrades was accidentally shot in the left buttock with a full charge of No. 6 shot, fired from an ordinary 12-bore gun, at a range of under six yards. This was definitely sworn to at the court of inquiry. The whole pattern could have been included within a circle with a four-inch diameter. There was no exit wound. The accident occurred within a few hundred yards of the hospital.

On admission the patient was found to be in a severe state of shock. Hæmorrhage was only very slight, some superficial grains of shot and particles of clothing were removed, anti-shock remedies administered and the wound painted with iodine and dressed with sterile gauze. Temperature that night rose to 99·4, morphia given on account of pain. The following evening his temperature rose to 102·6; as he was an old malarial patient a blood-smear was taken for malaria but proved negative.

Temperature the following day reached 103 and the patient was looking extremely toxic. Pulse correspondingly raised, wound of the buttock greatly swollen. I arrived the following day on receipt of a wire and found the following condition: Patient very ill, had vomited once or twice, temperature 102, buttock very swollen, typical foul smell, bubbling pus and mottling all over the gluteal region.

On palpation slight emphysema could be detected. Immediate operation and wide excision of the affected area was carried out; this included the removal of practically the entire gluteus maximus and a large amount of skin, laying bare the great sciatic nerve, which was found to be severely injured although not actually severed.

After-treatment consisted of continuous irrigation with Carrel-Dakin solution. Patient made an uneventful though slow recovery. He unfortunately suffered from nerve paresis of the group of muscles supplied

by the external popliteal nerve, with resultant drop-foot. The causative agent was confirmed by microscopic examination, *Bacillus aerogenes capsulatus* being found in almost pure culture.

The condition is one that cannot fail to be diagnosed by anyone who had the misfortune to serve in either a base hospital or a casualty clearing station, and without early radical treatment the condition is almost hopeless. We are now arriving at a new generation of younger medical officers who have not had the misfortune to come in contact with such cases. And these may fail to make an early diagnosis.

Case 2.—An elderly native woman fell from the verandah of her house, a distance of about twelve feet and sustained a compound dislocation of the right astragalus. She was brought to me the same afternoon.

Under general anæsthesia the astragalus was removed, it was only hanging on by a fragment of ligamentous tissue. The foot was replaced in position and the whole wound cleaned out. When she fell the wound was thoroughly fouled in the road drain. The following day the wound was looking unhealthy; dressed with eusol. Next morning, i.e., thirty-six hours after the accident, definite signs of gas gangrene had appeared, the limb was swollen and shiny as far as the knee, crepitant, with the usual bubbling pus.

Amputation was performed through the lower third of the femur. The posterior tibial vein was found occluded as far as the popliteal space.

The wound healed by primary union and he made an uneventful recovery.

I am indebted to Lieutenant-Colonel G. C. Cumming for permission to publish the case of Gunner C.

Sport.

A TREASURE HUNT AT NETLEY.

By Captain W. G. SHAKESPEARE.
Royal Army Medical Corps.

The sunny afternoon of April 21 saw a strange gathering outside the officers' quarters of Netley Mess. In response to the kind invitation of Major and Mrs. W. L. Webster to take part in a treasure hunt, fifteen cars were drawn up on the drive outside the Mess, and some seventy guests faced the camera with maps, trowels and compasses, while a photograph of the "Meet" was taken. It is hoped that the photograph here reproduced will not be misconstrued as illustrative of the flourishing condition of the R.A.M.C., for indeed the majority of the cars are the property of prosperous friends of the Mess, and if in one or two cases a "bus" does happen to belong to an R.A.M.C. officer it is highly probable that he is

still groaning under a series of monthly payments which the addition of Corps pay to his stipend would tend greatly to alleviate.

The photograph taken, the guests were summoned into the Mess ante-room, while Major Webster explained the rules governing the treasure hunt. There were, he said, seven clues to be found over a course of some thirty miles in Hampshire country. The first clues were hidden within six feet of numbers painted on the principal roads of the hospital grounds, these numbers corresponding with similar ones assigned to the cars themselves. Here, it may be remarked, that during the morning, Major Webster and Captain Shakespeare had been observed disporting themselves in the grounds with spades, trowels and a large pail and brush. They appeared to be playing a game which consisted of splashing each other with white-wash and then burrowing under a tree or into a bank, and many startled glances were cast in the direction of the two alienists, one young lady being heard to remark that they had "got it at last."

Major Webster told the intrepid treasure-seekers that if in the course of the hunt it became necessary to speak to anyone with reference to a clue, the one word "Treasure" was all that would be necessary, any other conversation involving waste of time and possibly loss of a clue. Then almost with tears in his eyes he besought the drivers of cars to respect the laws of their country and not to exceed the speed limit. And here it may be noted in passing that he ignored with fine disdain the remarks of certain treasure-seekers who most maliciously asserted that this was because his own car, a Ford of unknown date, could not possibly exceed twenty miles per hour. Finally he informed us that tea would be served in the Mess from 4.30 onwards. But little did those bold spirits who listened think what alarms and excursions they would be called upon to endure before they returned to "the cup that cheers but not inebriates."

Then we started off. At first there was a scene of some confusion as the fifteen cars went careering about to find their allotted numbers. As we passed and repassed each other in our search we were struck by the agility with which the ladies plied their trowels, and we could not help wondering if "the first gardener" did not owe a great deal of his horticultural success to the assistance rendered by Eve in much the same way. At length we found our number, and it was not long before we had dug up an empty "gold flake" tin containing the following lines:—

"With Palestine's most noted river find
My next. Then leave the Mess behind."

Surely some reference to the Jordan! And then remembering Sergeant Jordan of the Mess we hurried back to the quarters at full speed. Here we found Colonel Blackwell earnestly pleading with Jordan to tell him what he knew of the next clue. But the Sergeant was obdurate. "I'm sorry, sir, but I really don't know anything about it. No, I've no idea at all." Then suddenly the Colonel remembered, and roared with the full force of his lungs "Treasure." The word acted like a charm. With a

pleasant smile the Sergeant handed over a sealed envelope and incidentally the next clue.

Others were not so fortunate. One lady said "Why, of course, the padre has a bottle of Jordan water, the clue must be in his quarters." Breathlessly this particular car-load dashed off to the padre's house, burst into the hall, and—oh joy!—here was a sealed envelope lying on the table in the hall. But, alas, on opening it, nothing was found but the cryptic message: "My Dear, I shall *not* be in to tea," and some time was lost in writing a note of apology for a most unwarrantable intrusion.

The clue thus found ran as follows:—

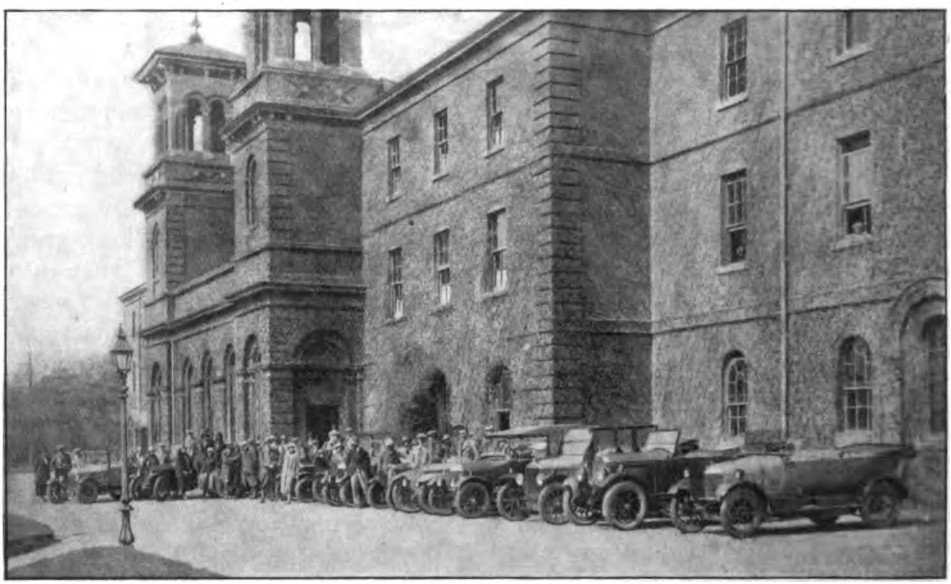
"Half way to Portsmouth stands a lion. Here
You may approach without the slightest fear.
He is a friendly beast of ruddy hue,
Go to his mistress, for she holds the clue."

And it was not long before fifteen cars were proceeding pell mell in search of an inn or hotel called the "Red Lion." Now all would have been plain-sailing had it not been for the fact that there are two "Red Lions" within a few miles of each other on the Portsmouth Road. The kindly landlady of the Fareham hotel had been enlisted as a willing conspirator in the hunt, and awaited no more than a whispered "Treasure" before giving the next clue to any breathless searcher who should rush into her hotel lounge. Unfortunately, the landlady of the first "Red Lion," situate at Burlesdon Toll, was not in the secret, and regarded the party of motorists who dashed at her screaming "Treasure," with an expression of amazement mingled with terror. But when Colonel Jack Powell, with a most disarming smile, and clinking two pennies in his hand, breathed "Treasure" into her ear a second time, she started backing towards a stout looking door, muttering as she did so, "Never, no, never in all me born days," and slammed it in our faces. Unfavourable, however, as our reception had been, it was nothing to what the occupants of the fifteenth car received from that irate lady. We were later informed that she pursued them with a broom and such horrible language for the best part of a mile, that they retired from the hunt determined that nothing on earth should ever induce them to take part in one again. The Fareham clue read as follows:—

"Lo! with the next clue waiting in his hands,
A guardian at the door of Knowleage stands.
One word to him and half your troubles end,
One word forgot, he will not be your friend."

This was rather more difficult. Opinion differed as to what constituted the guardian of the door of "Knowleage" with an "e," and presently a stream of cars was seen proceeding in divers directions, some to the Public Library and some to the Museum. General Carr, however, as befitted a Parish Councillor, plumped for the Fareham Schools, every one of which he raided within ten minutes, leaving the paralysed masters too astonished even to remember the four times table. And now occurred the only

tragedy of that memorable afternoon. There was a policeman on duty in the main street of Fareham. As he stood there, dreaming perchance of wife and children, or maybe of the steak and kidney pie that was to greet him at supper, a car stopped beside him, and a lovely lady, looking at him with an irresistible smile, murmured "Treasure." It is improbable that anyone so lovely had ever called him "Treasure" before, and small wonder was it that Robert stood rooted to the ground, staring open-mouthed at the vision. The lady continued to smile at him. "Treasure," she murmured again with a most beguiling air. And now Robert bestirred himself. A high-minded man, with a wife and family, and half the windows in the street facing him, he felt that something must be done, and done with the



least possible delay. So without a word, and with due regard to the proprieties, he turned both his back and a deaf ear on the Syren, and beat a hurried retreat up the High Street. But it was not long before another car stopped near by, and a young man hailed him. "Treasure" called the unsuspecting youth in accents which, although meant to be honeyed, were somewhat hoarse. Robert pulled up short. "'Ere, what's all this about treasure?" said he, now thoroughly roused and beginning to see a leg-pull, especially where there was a pair of Oxford trousers about. "Chuck it, will yer? Treasure, indeed"; and at this moment the tragedy occurred, as one of the hunters passed at a speed which was, to say the least of it, irregular. Up shot a peremptory arm. Out came a notebook and pencil. "Hi you! name, number and licence. Ought to be ashamed of yerself going at that rate. Treasure is it? *You'll* get treasure orlright. *I'll* see to that." Alas, I fear that Robert had never heard of Captain Blood,

otherwise there might have been kindlier feelings beneath his expansive chest on that sunny afternoon.

In the end the clue proved to be at the doors of the Knowle Asylum. What a winding and difficult road it was, and now as the cars drew together at the gates of the Asylum, a certain hesitation became apparent amongst the hunters as to what should be done next. True there was a stern-looking keeper marching up and down outside the door, but somehow one felt diffident of going up to him and breathing that magic word. After all we were practically in the Asylum itself; the keeper could not possibly know all the patients by sight; and such terrible mistakes have been made before now . . . it was an unpleasant thought. At last one bolder than the rest went up to the keeper, and it must be confessed that a more feeble attempt at *sang-froid* has rarely been witnessed. "Ha, ha!" said he, with a jocular air, "we are having a little treasure hunt, ha, ha! We thought you might know something about it you know—er—but if you *don't* it's quite all right." I suppose he meant to imply that *we* were all right, and we all laughed dismally in the rear in support of our spokesman. But the keeper said never a word, and continued his march, with bent head. Then at last one of us breathed a single word in his ear. What an actor the man was! Turning his back on us we saw he held in the hand clasped behind him a single blue envelope. That was all, and though other cars were crowding up to the doors it was improbable that anyone else saw the transfer except the recipient of the clue.

This was what we read:—

"Away, and seek the Bishop's telephone,
Entreat 14 for aid, and hurry on."

Here again there was a great deal of discussion. Some were for going over to ask the Bishop of Winchester if we might use his telephone, but milder counsels prevailed and we were reminded that there was a call office in the little market town of Bishop's Waltham. Arrived here we found a scene of indescribable enthusiasm, a string of cars outside the Post Office, and a homicidal postmaster staring with glassy eyes across the counter at a queue of dishevelled motorists who continually rushed into the telephone box, shouted "Treasure" and ran out again without paying their tuppences. Captain Alexander lost time here by proceeding to the Bishop's Palace to ask if he might speak from there. "We should be delighted" was the reply "only we aren't on the telephone." Those who murmured the word "Treasure" over the wires to Netley 14 received the following reply: "Within 300 yards past Botley Toll." Away then we sped towards the toll-gate, and arrived here we wondered where on earth the next clue could be. The roads were up; red flags and green flags were conspicuous everywhere; steam rollers were rolling, and British workmen scratched their heads and expectorated thoughtfully as one by one they were tackled with that mystic word. Indeed one was heard to say that they "weren't a-diggin' 'oles for treasure but a-laying drain pipes." Still

those of us who were fortunate enough to discern Private Hill of "D" Block, half-hidden in an enormous drain, were not long in taking the road once more in search of the final clue :—

"Where lads in blue say red is green,
And others that the moon is cheese,
Behold your clue. And here is seen,
A long straight row of leafless trees,
Now choose the tallest one of these,
Turn north-north east your eager face,
And then with well-judged steps and bold,
Halt on the sixth and hundredth pace,
At where the yellow gorse, I'm told,
Reflects the treasure's hidden gold."

Most of us reading this could guess that the final objective lay in the vicinity of "D" Block, and sure enough presently the first arrivals led by Captain Cormack were on the scene in the record time of one hour and thirty minutes. But here again there was a certain difference of opinion as to which was the tallest tree in the row, and having found it where was north-north-east? It was not long, however, before there came a delighted cry from one of the ladies as her trowel, and most of her arm too, disappeared through the turf near one of the gorse bushes on the field. To drag out the prize, to replace the turf, and to slip behind the hedge was the work of a moment, and scarcely had the winners hidden themselves than Colonel Blackwell and his party were hot on the clue. And now the cars began to arrive in quick succession, discharging their occupants on to the field until the grass was covered by a seething mass of competitors. Many of these, true to the spirit of buccaneering, crawled on all fours glancing fiercely about them and tapping the turf with their trowels as they did so, and it was not difficult to pick out those who were golfers by the scrupulous way in which they replaced any divots that were torn up in the search. But presently it became apparent that wherever the treasure had been at an earlier stage in the proceedings, it was certainly not there now, a conclusion which was shortly verified by the appearance of the winners from their concealment. The party was now complete, with the exception of one car which had broken down, and another which was wandering somewhere in the vicinity of Brighton in search of a possible clue. It was noticed, too, that many of the older hunters wore a haggard look as though they had gazed on Death many times in the course of the afternoon, as indeed they probably had, especially in the case of those whose drivers were young and reckless.

But as we took tea together in the Mess afterwards and fought the day's battles over again to the accompaniment of much laughter, it was agreed that never before had treasure hunters, whether in fact or in fiction, enjoyed themselves so thoroughly as we had that afternoon.

Current Literature—Pathology.

On the Toxin of the Streptococcus scarlatinæ. By Herbert Henry, F. C. Lewis, and others. *The Lancet*, 1925, i, 710.—This is a communication detailing a modification of the original Dick method of preparing the toxin of *Streptococcus scarlatinæ* for employment in the Dick skin test.

The organism is grown in Roux bottles on trypsinized agar which has been enriched by the addition of 1 to 2 per cent fresh rabbit blood or 5 to 10 per cent human pleuritic fluid. The surface of the medium is flooded with two cubic centimetres of a broth culture of *S. scarlatinæ.* After incubation for eighteen to twenty-four hours, five cubic centimetres of carbol saline is added to each bottle and the resulting suspension is decanted. The contents of several bottles are pooled and centrifuged at high speed. The supernatant fluid is filtered through a Berkefeld candle, tested for sterility and put up in dilutions suitable for the skin test. Satisfactory Dick reactions followed injection of a toxin prepared in this manner and diluted to from 1 in 2,000 to 1 in 30,000. It is emphasized that the efficacy of the method depends on the short period of incubation; more prolonged incubation was found to reduce the potency of the toxin. In addition to simplicity, this method has the further advantage of producing a toxin which seldom causes pseudo-reactions.

The latter part of the communication deals with the preparation of a dried toxin by precipitation with alcohol. H. M. P.

Tuberculin Tests in Cattle, with Special Reference to the Intradermal Test. Medical Research Council Special Report. Series No. 94.—The investigation of the intradermal skin test was undertaken in view of the fact that in certain instances in undoubted cases of tuberculosis of cattle the subcutaneous test gave either negative or doubtful results. Further, the variation of temperature following the subcutaneous injection of tuberculin might cause a fallacious interpretation owing to the fact that in normal animals this variation has been shown to occur. Another disquieting factor in the present method of testing is in the standardization of the brand of tuberculin employed in the test. In one series of tests, made on undoubtedly tuberculous cows, the brand of tuberculin employed gave entirely negative results.

The tuberculin used throughout in the intradermal tests has been "old" tuberculin, which consists of an aged broth culture of the tubercle bacillus, concentrated by heat, sufficient to kill the organisms, to a tenth of its value and freed from bacilli. This tuberculin is standardized as regards potency by ascertaining the dose necessary to cause the death of

a guinea-pig which had been infected some weeks previously with virulent tubercle bacilli, and comparing this dose with that of a tuberculin of known excellence, all the guinea-pigs being infected with the same emulsion of tubercle bacilli on the same date.

Technique of the Intradermal Test.—The value of the intradermal method of applying the tuberculin test has now been well established in this and in other countries. The test is carried out in two stages:—

(1) A preliminary or sensitizing injection.

(2) The test dose.

The value of this double test has been emphasized by American work, but it has not been extensively used in this country.

The tuberculin employed is an undiluted sample which has been standardized by the above method.

The dose employed is usually 0·1 cubic centimetre both for the sensitizing dose and test dose.

The site of injection is usually the fold at the centre of the side of the neck.

An area of two to six square inches is shaved with a safety razor. A fold of the skin of the shaved area is taken between the forefinger and thumb of the left hand and firmly held. A short strong needle of the dental type is inserted obliquely into the fold, so that the point is from two to three millimetres below the epidermis, and the tuberculin is forced into the derma. The correct injection of the tuberculin is evident by the formation of a small pea-like swelling, situated in the thickness of the skin, at the site of inoculation. The second dose is given from forty-two to seventy-two hours after the first dose and in the same manner.

Observation of the Results of the Test.—Before the first injection the thickness of the fold of skin should be measured by a pair of calipers. The average thickness of the fold is 5·6 millimetres, and varies from four to six millimetres in cows. Twenty-four hours after the injection of the first dose the fold is again measured. In all animals there is almost invariably an increase in thickness. In non-tuberculous animals it rarely exceeds a few millimetres, while in tuberculous animals it mav vary from ten millimetres to seventy millimetres or more. After a further interval of eighteen to twenty-four hours the fold is again measured. In non-tuberculous animals there is usually a slight decrease in thickness; in affected animals there is generally some increase in thickness, but occasionally no change is observed. A measurement should always be taken immediately before the second or test dose, and again twenty-four hours after this injection. The second injection is usually given forty-eight hours after the first, but the interval may be prolonged to seventy-two hours. Non-tuberculous animals show little or no increase in thickness; on palpation the site of injection usually remains as a pea or bean-like swelling with no surrounding œdema and no heat and tenderness; on the other hand, in tuberculous animals the measurements are without excep-

tion considerably increased, and palpation reveals a varying degree of surrounding œdema and increased local heat and tenderness. The examination made twenty-four hours after the second injection is the most important of all, as at this period a definite conclusion on the results of the test can be usually reached. It is now that the value of the double dose can be appreciated, for it is almost invariably found that many animals which gave an indefinite reaction to the first dose are now definitely positive.

The Ophthalmic Test.—This consists of a double installation of tuberculin, the first or sensitizing dose being applied at the same time as the first intradermal injection. The second instillation is made forty-eight or seventy-two hours after the first. The tuberculin used is an undiluted sample of unpurified tuberculin. The dose is one drop for sensitizing and two to five drops for the test dose. The eyes are examined twenty-four hours after the sensitizing dose, and twenty-four hours after the test dose.

Results of the Tests.—Animals of all ages and many types were included in the series of combined intradermal and ophthalmic tests, and the results were very consistent. Young animals which were extensively infected reacted well to the test, as did those which were suffering from an acute form of the disease. Likewise old cows, whether showing a marked or slight infection, appear to react definitely. It is concluded, therefore, that the intradermal test can be relied upon for the detection of tuberculosis in quite young animals. This is of considerable economic importance, as the previous custom of waiting for a positive reaction in the adult animal before disposing of it favoured the dissemination of tuberculosis throughout the herd. The elimination of the young as well as the mature reactors is now feasible.

The Dick Test in Scarlet Fever. By C. C. Okell and H. J. Parish, *Lancet*, 1925, vol. i, p. 712.—This paper is concerned with a number of observations made in this country on the Dick test, and is in continuation of a number of similar observations already reported by Okell and Baxter.

The toxin used in the reaction was prepared by the authors, and the test dose was 0·2 cubic centimetre of a $\frac{1}{8000}$ dilution. In susceptible individuals positive skin reactions were well marked and were of an average size of 20 by 30 millimetres. Inactivation of the toxin for the control injection was affected by heating it to 96° C. for forty-five minutes. The test solution of toxin retains its potency for at least two weeks, which stability is in contrast to diluted diphtheria toxin. Toxins prepared from various strains of *Streptococcus scarlatinæ* were found to possess identical properties. Further, all toxigenic strains of the organism examined could be classified in one serological group.

The technique of the Dick test is for all practical purposes the same as

the Schick test, the reactions being classified as in the latter test into positive, pseudo and positive (combined reaction), negative, and pseudo-negative.

The positive reaction makes its appearance more rapidly than in the case of the Schick test, reaching its maximum in from six to twelve hours. It is evident as a bright red flush of an average dimension of 20 by 30 millimetres. It fades more rapidly than a Schick-positive reaction, and has almost completely disappeared seventy-two hours after the injection. The negative reaction is marked by the absence of any flush at the site of inoculation.

The series of tests published by the authors consists of (1) a normal group, (2) a convalescent group.

Normal Group.—The number of individuals included in this group is ninety-five. The positive rate was seventy-four per cent, the negative rate twenty-six per cent. Of the number tested twenty gave a previous history of scarlet fever, and of these sixty-five per cent gave a positive reaction, and thirty-five per cent a negative reaction. A negative history of scarlet fever was given by seventy-five, and amongt these individuals the positive rate was seventy-six per cent and the negative rate twenty-four per cent. In this series of tests pseudo-reactions were not commonly observed.

Convalescent Group.—This group consisted of 120 cases of scarlet fever, from the second to the twelfth week of convalescence. Positive reactions were given by eighteen per cent, negative reactions by eighty-two per cent.

In the discussion of the results of the tests it is suggested that the high Dick-positive rate of sixty-five per cent in the normal group with a previous history of scarlet fever may be due either to unreliability in the history of the individual or to a diminished immunity to the toxin owing to lapse of time. In attempting an interpretation of the Dick-positive rate of eighteen per cent in the convalescent group certain possible explanations are advanced, such as mistake in clinical diagnosis, individual lag in readiness to immunization by the toxin. The authors conclude that their experience of the test in this country is in agreement with that of Dick and Zingher. H. M. P.

On Structures which develop in certain Culture Media and resemble Colonies of Micro-organisms. By P. P. Laidlaw. *British Journal of Experimental Pathology*, 1925, vol. xi.—In view of the large amount of work being published on filter-passing viruses this paper has considerable interest.

The author found, whilst conducting experiments upon the cultivation of filter-passing viruses in enriched media, that certain colonies consistently grew out, which resembled in a great many ways colonies of micro-organisms.

The colonies were translucent, could be picked off and stained by Giemsa's stain. Apparently they could be cultivated indefinitely, and development took place more rapidly under anaerobic conditions.

Emulsions of the colonies had no effect on animals, the same type of colony was secured from several viruses of quite different natures, a similar appearance developed on a slope inoculated from a sterile Noguchi tube, and finally "development" was found to be unimpaired by autoclaving for thirty minutes.

These "colonies" on further investigation were found to resemble in every way a sphærocrystal of fifteen to twenty microns. Although the amount obtained of these "cultures" was too small for any accurate analysis, it is believed that the sphærocrystalline masses consist for the most part of soaps of calcium and magnesium.

The explanation is that these calcium and magnesium soaps of fatty acids, formed under the conditions of experiment, remain dispersed in a colloidal system until conditions are altered by the introduction of a few small crystals, or even by scratching the medium with a platinum wire.

It is interesting to note that once these artifacts develop the media cannot be used for the purpose for which it was prepared. H. D. B.

Reviews.

SERUM DIAGNOSIS OF SYPHILIS BY PRECIPITATION. By R. L. Kahn, Sc.D., Immunologist to the Bureau of Laboratories, Michigan Department of Health. Publishers: Williams and Wilkins Company, Publishers of Scientific Books and Periodicals, Baltimore, U.S.A. Agents: Baillière, Tindall and Cox, 8, Henrietta Street, Covent Garden, London, W.C.2. Price 3 dollars.

This book gives the detailed studies of the author's work during the past three years, during which time over 100,000 tests have been performed. The test is a great advance on the work hitherto done in this direction because of its simplicity and the rapidity with which it can be carried out, and the facility of interpretation. Great importance is laid on the concentration of the ingredients employed in the reaction. As in most precipitation tests the variations likely to be encountered in the alcoholic extractions of the antigen have yet to be overcome. From a diagnostic point of view, as compared with the Wassermann test, the results are very convincing. In primary syphilis the reaction is found to be more sensitive than the Wassermann test. In secondary syphilis the reaction gives an equal number of positive readings. In tertiary syphilis, excluding cerebro-spinal disease, the reactions are more sensitive than the Wassermann test. In the diffuse type of cerebro-spinal syphilis with general paresis the test is equal in sensitive-

ness to prolonged fixation Wassermann reactions. In locomotor ataxia the reaction is more sensitive than the Wassermann. In congenital syphilis the reaction is similar to the Wassermann test.

Chapters VI, XIX and XXV are especially interesting. In Chapter XXV details are given regarding the technique adopted and the value of the reaction as a quantitative test in cases undergoing treatment. This procedure may prove of great value in its clinical application as an index to the curative properties and essential doses of the various new preparations used in the treatment of syphilis.

The writer has made his subject extremely clear and accurate in detail. The volume contains five photographic plates, numerous tables, and is well indexed. The book is a good presentation of the relative value of the serum diagnosis of syphilis by precipitation as compared with the older Wassermann procedure. The author is to be congratulated on his work, which should prove most useful to students of this important subject.

W. F. M. L.

THE REFRACTION OF THE EYE. By Ernest Clarke. London: Baillière, Tindall and Cox. 1924. Pp. iv + 251. Price 8s. 6d.

Under this heading is included elementary optics, the refraction of the normal and ametropic eye, retinoscopy, the correction of errors of refraction, and the ordering of spectacles, the various forms of squint and their treatment, and the detection of malingering.

These subjects are presented in a simple and attractive way, and there is a minimum of explanatory mathematical formulæ. It is an excellent book for those taking up refraction work. In addition to the subjects already enumerated there is a chapter on "Eyestrain"; in dealing with this we consider that the author has indulged in a good deal of over-statement of the case. That uncorrected errors of refraction are a cause of headaches we readily admit, but that eyestrain is a cause of dyspepsia, constipation, alcoholisms, drug taking, the pretuberculous stage, etc., as is suggested, is fanciful conjecture, as also the statement that uncorrected low degrees of astigmatism are a cause of cataract.

Imaginative flights like these, uncontrolled by evidence, are out of place in a work of this kind.

On pages 215, 216 there are inaccuracies in the figures given. Cylinder 0·37 is given as the result of a combination of various lenses; it should be 0·38; this occurs twice. Cylinder 0·87 is given instead of cylinder 0·88.

LABORATORY DIAGNOSIS OF SYPHILIS. By Hideyo Noguchi. London: Humphrey Milford, Oxford University Press. Pp. 393. Price 36s.

The first twelve chapters of this book contain a very complete description of the serum-diagnosis of syphilis by tests of the Wassermann type. There is a full discussion of the different reagents used by various workers.

The author's method of performing the Wassermann test is given in detail. Noguchi is not in favour of using extracts fortified with cholesterin, which have been in almost general use in this country since they were introduced by McIntosh and Fildes, and which are found to give excellent results.

Chapter XIII treats of Specific Complement-fixation in Syphilis rendered possible by the author's successful cultivation of the *Spironema pallidum*; and although this test is not at present of much practical value, it is of great interest.

A serious omission in a book written so recently is that there is no description of flocculation tests of the Sachs-Georgi type, there being only an extremely short reference to this test in the chapter dealing with cerebrospinal fluid.

No. XIV is an excellent chapter on the author's luetin test, well illustrated by coloured plates.

The cerebro-spinal fluid is dealt with in one chapter, and, in addition to the usual tests, there is described a new test by the author and Miss Tilden. It is noticeable that cell-counts receive only casual mention.

In the chapter dealing with methods for the detection and study of the *S. pallidum*, all the spironemata and spirochætes described are designated Treponemata, and their descriptions are disappointingly brief, but this is compensated for by a series of beautiful photographs.

The book contains many useful illustrations and tables, and there is an extensive bibliography.

A work by an author of the repute of Hideyo Noguchi is expected to be of outstanding merit, and we consider that specialists and others interested in the laboratory study of syphilis will not be disappointed with the material presented in this volume.

A Contribution to the Study of Pernicious Anæmia and Aplastic Anæmia. By Arthur Sheard, M.D. Bristol: John Wright and Sons, Ltd. London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd. 1924. Pp. vii + 94. Price 7s. net.

This is a thesis presented for the degree of M.D. in the University of Leeds; it deals with fifteen consecutive cases of pernicious anæmia, one of hæmolytic jaundice, simulating pernicious anæmia, and one of plastic anæmia. To this is added a review of all the cases of pernicious anæmia admitted to the Leeds General Infirmary during the past ten years. In summing up the ætiology of pernicious anæmia the author considers that the condition constitutes a clinical entity occurring only in individuals who already have achlorhydria, the essential causative factor being an infective agency located somewhere in the gastro-intestinal tract; though the nature of the infection remains unknown, he infers that it may be one or more toxins of bacterial origin. He urges the importance of early diagnosis, and points out that the classical sign of a tinted pallor is a

comparatively late one ; hæmatological examination and an analysis of the gastric contents in suspected cases must be carried out early.

The author illustrates his thesis with plates and a chart. The appendices contain the case reports and analyses of cases. The bibliography is extensive. He has published an interesting contribution to the study of pernicious anæmia, a disease that, in his own words, "all efforts to unravel completely the mystery of its ætiology have hitherto been doomed to failure." M. B. H. R.

FRACTURES AND DISLOCATIONS. By Wilson and Cochrane. London : J. B. Lippincott Co. 1925. Pp. xv + 789. Price 45s.

This volume contains a description of the methods of treatment practised at the Massachusetts General Hospital under the direction of the Fracture Service Staff of that Institution.

At the commencement of the book is a general survey of modern fracture treatment, and the problem of fracture treatment is very thoroughly dealt with.

The authors point out that the final goal of treatment is to restore the full functional activity of the limb in the shortest possible time. To reach this goal, however, the surgeon must always keep in mind several distinct therapeutic objectives.

Sound bony union, correct alignment, freely movable joints, supple muscles, and a good circulation have all to be considered.

The various methods of fracture treatment are grouped for examination under four headings :—

(1) Reduction and fixation.
(2) Massage and mobilization.
(3) Traction.
(4) Open operation.

A clear short review of each of these methods is given and the surgeon is advised to consider carefully not only the advantages but also the limitations of each.

The authors point out that while a certain number of fractures can only be treated successfully by the open operative method, the majority of fractures can be well treated by simpler and safer methods. They consider that the surgeon would be well advised not to operate upon a fracture, unless he has first tried the traction method, and found it to fail.

The various typical joint and bone injuries are described in separate chapters and are easily referred to. A special feature of the work is a short, well-illustrated description of the normal anatomy of the part under consideration, at the commencement of each chapter. The anatomical description not only refreshes the memory of the reader, but greatly facilitates the explanation of the various movements and manipulations required for the reduction of displaced or fractured bones.

The open operative method of fracture treatment is not dealt with in

great detail, as the authors feel that the book is essentially written for the guidance of the general surgeon.

In addition they consider that there is a distinct modern tendency towards conservatism in fracture treatment, attributable largely to the recognized efficiency of the traction method.

When undertaking the open operative method for treating a fracture, the authors prefer to use absorbable material for internal fixation, such as beef-bone, ivory, or kangaroo tendon, in preference to metal plates, screws, etc.

The importance of early and efficient splinting in the treatment of fractures is pointed out, and the standardization of a few simple splints of proved efficiency is strongly recommended.

The treatment of compound fractures and infected wounds is dealt with and the value of débridement and the Carrel-Dakin method of treatment is emphasized.

The general principles which should guide the surgeon in the choice of primary, delayed or secondary suture in the treatment of wounds are well described.

The book is very well illustrated with excellent diagrams, photographs and radiograms, and the fact that it represents practically the unanimous opinion of a group of surgeons specializing in this branch of surgery adds greatly to both the interest and the authority of this work. C. C.

TREATMENT OF GONOCOCCAL INFECTION BY DIATHERMY. By E. P. Cumberbatch, M.A., B.M., B.Ch.Oxon., M.R.C.P., and C. A. Robinson, M.A., B.Ch.Cantab., D.M.R.E.Cantab. London: William Heinemann. 1925. Pp. vii + 150. Price 7s. 6d.

This monograph is a record of results in the treatment of gonococcal infection by diathermy and a description of the various methods employed.

The subject matter is treated in a book of 150 pages, comprising a preface, twelve chapters, an appendix and an index.

There is no doubt that a diathermy apparatus is an essential in every gonorrhœal treatment clinic.

It has long been known that the lethal temperature for the gonococcus is relatively low. The organism can be destroyed by exposure to a temperature which is not high enough to damage the living tissues. In the past many attempts were made to effect this by means of hot bougies, radiant heat, etc., but without success, owing to inability to maintain a lethal temperature in the part under treatment. This difficulty has now been overcome by employing an electric current which alternates with extremely high frequency, converting the tissues into the conductor with the production of heat. The heat produced can be regulated and the necessary temperature maintained. The authors describe the methods employed for the application of diathermy to various regions of the body.

It is, of course in gonococcal complications and lesions outside the urethra that its value is greatest. It is the best treatment for acute epididymitis, prostatitis and arthritis. The point is emphasized that the causative focus must always be treated in a general gonococcal infection—for example, treatment of an arthritis alone is of little value if the cause of the process in the prostate and vesicles is neglected. The treatment of urethritis presents many difficulties owing to the anatomical conditions, and diathermy, especially when applied to the whole length of urethra, has not always been satisfactory.

This monograph is an extremely useful contribution to the successful treatment of gonorrhœa. It is well written, and can be read with much benefit by all who are interested in the subject.

Reports and Analyses.

MAY AND BAKER, Limited (Battersea, S.W. 11), have issued a useful booklet describing a number of their pharmaceutical preparations. The constitution of the products is given, also their therapeutic indications, methods of use and dosage.

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The effect on arsenical dermatitis and jaundice is striking, and the withholding of this drug in severe cases of this nature would be a grave responsibility for those concerned.

The preparation Ametox fully justifies all the claims made for it.

Correspondence.

THE ORGANIZATION OF THE FRENCH ARMY MEDICAL SERVICE IN THE FIELD.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—Having read, with much interest, Major Stirling's contribution entitled "The Organization of the French Army Medical Service in the Field," which appeared in the August number of our magazine, may I suggest that he be asked to publish what one might describe as a "key," for the benefit of those of us who are ignorant on the matter. Such a key would indicate, where possible, the units of the British Army corresponding to the French ones mentioned, the strength of French units and formations mentioned, the bed capacity, etc.

I feel sure that a key would increase the value and interest of the article, and hope that Major Stirling will see his way to amplifying it in some such way as I suggest.

I am, etc.,

Sept. 30, 1925. H. S. BLACKMORE,
Major R.A.M.C.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Any demand for *reprints, additional to the above*, or for excerpts must be forwarded at the time of submission of the article for publication.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be typewritten; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

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The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, a volume commencing on 1st July and 1st January of each year.

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Original Communications.

RESEARCH IN THE MEDICAL SERVICES.[1]

BY LIEUTENANT-GENERAL SIR WILLIAM B. LEISHMAN, K.C.B., K.C.M.G., F.R.S., ETC.
Director-General Army Medical Service.

MAY I, in the first place, express to the Section my sincere thanks for the honour they have done me in appointing me to be their President for the ensuing Session? I feel this to be a very high compliment, and I can assure my fellow-members that I will do all that in me lies to secure their interests, and to maintain the work of the Section at the high level which it has reached under the wise guidance of my distinguished predecessors in the Chair and their energetic secretaries.

Considering our youth I think we have reason to congratulate ourselves on the evidences of vitality demonstrated at the meetings. The wide range of subjects which have been brought forward, and the valuable discussions to which they have often given rise show that there is abundant justification for our existence, and that there is a general feeling among the Services that its meetings are of value to them.

The attendances at the Sectional meetings in the past may, I think, be regarded as fairly satisfactory, especially when we consider how few serving officers are stationed in or near London; but, though I trust we may see some improvement in this direction, it will, I fancy, always be the case that a Section constituted as we are must rely on reaching the main body of the members through the printed transactions. It is in my mind to discuss with the Council of the Section whether, recognizing this point, we may not organize some machinery which would have the

[1] Being the Presidential Address delivered before the War Section of the Royal Society of Medicine on October 12, 1925.

effect of bringing before the meetings a larger volume of comment and experience in connexion with the subject of discussion from those whose views we should value, but who, for various reasons, are unable to be present in person.

Another point I should like to mention before turning to the subject of my address. Representing as we do the Medical Services of all the fighting forces of the Crown we have naturally brought forward at our meetings papers which, from their title, might give the impression that they would be of interest only to the particular service to which the writer belonged. This may, and probably does, do something to limit the attendance of some members who may regard it as unlikely that they would learn anything of interest or value to themselves. This I believe to be a mistaken view; at any rate, to judge from my own experience, I have listened with pleasure, and derived great benefit from papers and discussions on subjects from which I was, perhaps, anticipating neither the one nor the other. Modern warfare, like medical science itself, becomes increasingly complex and many-sided, and we cannot tell from month to month what new branch of knowledge we may have to familiarize ourselves with or in what new direction some subject, hitherto regarded as the other man's job, may become of direct importance to ourselves. Yet again, I am one of those who consider that we often get most valuable and suggestive criticism from those whose lines of work are altogether different from our own, but from whom some aspect of our subject or problem called forth a question or a comment from an unexpected angle. May I hope, then, that we may have yet fuller discussions of our papers and that the members of the sister Services will not hesitate to join in even if the subject matter be confined apparently to one of them. I hope it is quite unnecessary for me to add that we look on all the members of the various Reserve Forces, as well as our comrades of the late war, as part of ourselves.

The subject of the introductory address, which it is customary for the new President to deliver, has exercised me considerably. I was soon forced to recognize that it was not in my power to prepare in the time at my disposal a paper upon some specific subject which might lie within my competence, and which might be worthy of the occasion. I have, perforce, had to choose one of a general nature, and, not unnaturally perhaps, have selected that in which I have had a deep interest for a large part of my career in the Service—research.

At the outset it is my purpose, if I can, to remove from your minds the impression that research is of necessity an esoteric matter, confined to mysterious laboratories and that it can be carried out only by professors and specialists who have given years of work to their subject, who are a "peculiar folk" and talk in a tongue "not understanded of the people." It is true that much experimental inquiry demands expert knowledge and special equipment, and comes within the opportunity of

comparatively few of us, but I prefer to give to the word research a much wider significance and to take it to cover any means by which we, of set purpose and on a deliberate plan, strive to add to the existing knowledge of the cause, the prevention and the treatment of disease. I have on more than one occasion spoken on this subject and have urged in connexion with it a far closer collaboration for this purpose between clinician and specialist than exists at present.

Let us examine in some detail our position as medical officers of the fighting Services *vis-à-vis* this question of research.

It is not my intention to dwell on the admirable research work which is in continual progress in our respective colleges and laboratories, nor to point out the moral of the incalculable benefits which the Services have enjoyed as a result of much of that work. This would leave no time to deal with anything else and I prefer to speak of the present, and still more of the future, rather than of the past.

I am bound to admit that the present moment does not appear to be an ideal one for suggesting that, with our diminished personnels, overworked officers should voluntarily add to their heavy work; but, after all, we are only passing through a period of depression, and such periods, familiar enough to those of us with long service, pass, and have usually been followed by conditions better than those that preceded the negative phase.

Be that as it may, I know I am not exceptional in holding as a firm belief that there is a profound difference between work which, however conscientious and good, is more or less of a routine, and that which is varied and which brings with it continual new interests. Anything in the nature of research, understood in the broad sense I mentioned just now, belongs definitely to the latter category and has the further great attraction that it brings us into that closer intellectual sympathy with our colleagues which is one of the results of the pursuits of a common purpose.

Let us now look for a moment at the very exceptional facilities and opportunities which we of the Services possess; they are indubitable and, I believe, far greater than those enjoyed by the great majority of our confrères in civil life. First, and most important, our material. Whether sailors, soldiers or airmen, those of whom we have the honour to be in medical charge become, if we wish, our friends and comrades throughout their service; where they go we go, and their health and physical well-being is not only our charge but is to us an open book throughout their service, wherein we may read, and perhaps even write, as we will. From their examination as recruits till they leave the colours their physical standards and their medical history are recorded and they are under our daily supervision. What would not our civil brethren often give for such an intimate knowledge of the past history of a patient; there is nothing like it, except perhaps in some schools and institutions and in relation to some of the notifiable diseases such as tuberculosis. The fact that the men, like ourselves, are subject to discipline brings in another element of greal value,

inasmuch as it renders possible such things as systematic or periodical examination, the employment of uniform standards of procedure, etc., which are as a rule totally impracticable elsewhere.

As to the opportunities for medical research in connexion with this exceptional material there is no need for me to remind my brother officers of both the abundance and the variety of the morbid conditions which come under our observation in officers and men and among their wives and families. This is less appreciated, unfortunately, by many outside the Services where there are still many misconceptions as to both the volume and the nature of our work, and it is not rare for us to read, or to hear, that our opportunities are meagre, that we see but the commoner ailments to which healthy young manhood is liable and that the bulk of our experience is in the treatment of minor complaints and venereal diseases. This was not true even when I joined the Army in 1887, and nowadays, in that Service, the volume and importance of the medical and surgical work compare favourably with that of all but the largest of the metropolitan or provincial hospitals. The change of policy which has resulted in the concentration of the troops in a smaller number of large stations has been followed naturally by a similar concentration of the medical organization—greatly to the benefit of the Army, the taxpayer and ourselves. I am naturally not so intimate with the situation in the Navy, the Air Force and the Indian Medical Service, but I have good reason to know that they are in most matters as favourably situated as ourselves, while the records of past meetings of this Section bear abundant evidence to the good use they make of their opportunities.

Medical and surgical material, then, is abundant and varied, both at home and abroad, and we are most favourably placed to observe our cases from start to finish and, if we wish, to follow them up afterwards.

Turning to another side, we can readily make use of our respective organizations for the employment of the technical aids to diagnosis and treatment with which medical science has been so greatly enriched in the last thirty years; and one acknowledges gratefully that we are able to maintain our equipment for theatre and laboratory in a condition well abreast of all modern requirements. Whatever tests may be considered as helpful to diagnosis or as accessory to treatment are readily available, and if the specialist and his tools cannot be brought to the patient, the patient if necessary is transferred to the hospital where he will find the pathologist, the radiologist, or other expert whose skill is needed. Further, should we feel that our own resources in skill or experience are insufficient in a difficult case, we are indeed fortunate at home in being able to call upon one of our distinguished consultants, whose ready and valuable help it is impossible to acknowledge adequately.

We are thus able, in all but the most isolated stations at home or abroad, to investigate fully all our cases, to observe their progress accurately and to make permanent records in relation to any facts of importance.

These are great assets for any medical man, and if we do not benefit by them to the full the fault is our own.

Such then being the present position as regards material and facilities in the Army Medical Service, and also, I am confident, in the sister Services, let us turn to the use which we are making, or may make, of them to further medical science by observation and research.

As to the past, each Service has a record of research of which it has every reason to be proud and even our youngest sister has lost no time in making her permanent marks on medical progress. As I have said, I do not intend to enumerate even the more important and outstanding of these researches but will only point out that, for the most part, they were the work of men who had had the advantage of special training in some line and who enjoyed special facilities either in the way of exceptional access to fruitful material or in the use of well equipped laboratories. At the same time this was far from being the case in all instances, especially in the past when specialism and laboratories were rare, and many most valuable contributions to knowledge were made by men who had to rely solely on themselves and had to create and utilize their own opportunities.

What would not many of our forebears have given to profit by the benefits which we have inherited? Apart from the volume of new knowledge which lies to our hand, we all enjoy the further inestimable privilege of going through an admirable post-graduate course, just at the moment in our professional life when we can benefit by it best; that is when we are old enough to have acquired a wide experience of men and of other lands and are still young enough to retain energy and ambition. Whether or no our professional predilections are sufficiently defined to lead us to seek for further special instruction in a particular branch, we are all of us, at the least, given the chance of bringing ourselves well up to date in our rapidly moving profession.

The point which I now wish to make is this. In my view, everyone who has reached this stage in his Service career is well equipped to make valuable original observations on many lines of professional work, either alone or with the readily available help of his specialist comrades. Not that I would for a moment suggest that such work need be deferred till then, but one recalls how, in one's earlier years, one feared to slip up by publishing observations on views which, through our inexperience, might either prove not to be novel or to be inadequately controlled and documented.

Apart from the desirability of attempting such research work for its own sake, and for the general advancement of our profession, there is, I imagine, little need for me to emphasize its value to the individual. Not only would it make his professional life infinitely more interesting but there is always the chance that a particular investigation might end in bringing to light something of great importance, one result of which would be, if justice is done, as it usually is in the end, that the investigator's name

would become associated with the observation and he would find he had taken a definite step forward out of the class of "also ran." I would, however, warn anyone who, on the strength of this advice, felt inclined to try his wings in this direction that two qualities are essential to any chance of success: absolute honesty and infinite patience. One needs really something of the qualifications of the fly-fisher, for whom there is such hope in every cast that it will carry him happily through a blank day leaving him with cheerful anticipations of the morrow.

One other word of counsel. Much careful and good observational work fails to obtain full acceptance and credit for lack of record of some observations or tests which a critic might consider essential to the acceptance of the conclusions. In such cases collaboration with a specialist colleague is most desirable, and is most valuable to each.

Let us now consider for a few moments what kind of inquiries might be set about and in what manner the material which lies to our hand might be utilized. You will perhaps forgive me the presumption of attempting to advise beginners in this matter on the slender ground of having been, in my past life, a specialist in one branch. Putting myself, as far as I can, in the position of a young officer who has not as yet attempted anything of this kind, I should begin by asking myself "in what line of professional work am I most interested and would most wish to become expert?" The answer, I am sure, would be clear and prompt. I should then sit down to think over the many branches of that subject, finally selecting one or two of them for a closer scrutiny. I should lay special stress on the cases which, in my own experience, had puzzled me and in which, for example, I had felt unsatisfied as to the current explanations of their ætiology or in which the treatment in common use had proved, in my hands, unsatisfactory. It would not be long, I fancy, before a certain number of such instances occurred to one. Of these I should select one or two and proceed to soak myself in the recent literature of the subject, incidentally subscribing to one of the technical journals dealing with it. One would soon realize that many others had encountered the same difficulties and would find oneself stimulated by their new points of view and their own conclusions. By degrees you would, I am sure, find yourself becoming more and more critical of these conclusions, so often expressed with dogmatic confidence, and you would begin to ask yourself, "why does this fail to convince me?" or, "how am I to reconcile this result with what has been recorded by X, Y or Z?" Next in order comes the stage at which one begins to think "would it not be possible to settle the point if I were to do—what?" If one accepts the mental challenge *that* is the starting point of a specific piece of investigation and one must then begin to plan the campaign. Assuring oneself, in the first place, that sufficient material is already available, or can be made available by a little private organization, you ask, "how can I make and record these observations in such a way that a clear-cut answer may be obtained to the questions I have asked myself?" In

this it must be kept clearly in mind that you have to convince not yourself only but others who, when they come to read your work, will be quick to notice the absence of certain relevant details or the inadequacy of your "controls." It is impossible to take too much trouble over this planning of the inquiry, for, if every fallacy is not thought of beforehand and guarded against as far as possible, one may waste much effort and have to start afresh.

Unexpected difficulties, failures, interruptions, are the daily bread of the inquirer, but, if met with cheerful philosophy, and still more if one is wise enough to have prepared more than one string for one's experimental bow, one may confidently anticipate reaching a result worth communicating to a society or journal and will have achieved an altogether new outlook on professional work and acquired that admirable thing—a new interest in life.

Each man has different tastes and different aptitudes, but, in the extremely varied work which falls to us in the Medical Services, it would indeed be strange if one could not find, within working distance, both the subject and the material for commencing such an inquiry as I have outlined. The tropical diseases are bristling with unsolved problems of ætiology, of treatment and of prevention, and our opportunities in this line, when on foreign service, are unbounded. The Navy and the Air Force have, I take it, no lack of unsolved problems, special to themselves; while, in the Army, there are a host of morbid conditions, some of them of first-grade military importance, in which our special facilities should give us a better chance of adding fresh knowledge or of clearing up difficulties than falls to the lot of most of our brethren. Again, to the considerable number of us to whom preventive medicine makes a stronger appeal then clinical work, the difficulty will be to choose one out of the hosts of problems which are presented to us by the rapid development of this subject.

So far, I have been speaking of the individual inquirer who wishes to choose and follow up for himself a particular subject. Let me now say a word or two on collective research, a method of inquiry which so far has not been very widely used in the Services. By this is meant that a selected problem is investigated by a number of workers in different places who follow an agreed plan and conform to certain rigid standards as to the material and the methods to be employed. I have always thought that there were great possibilities in connexion with this method and that the conditions which should make for success were exceptionally favourable in the Medical Services. In the case of the Army our research organization is readily adaptable to such a method and a certain number of such investigations have been commenced since the Directorates of Pathology and Hygiene were created. As no doubt you are aware in each of these subjects our Director has the advantage of a technical Advisory Board to which highly qualified civilian experts have been nominated. At their meetings subjects possibly suitable for such research are examined, and, if

one is chosen, the details of the inquiry, the methods to be employed, the mode of recording, collecting and analysing the results, etc., are fully discussed and decided upon. The detail plan is then communicated to the specialists in suitable Commands who get down to work on the subject on a common plan and using a common technique. I may enumerate a few of the subjects so chosen, merely by way of illustration.

(1) Influenza.—The incidence of Pfeiffer's bacillus in the sick and in contacts, in the presence and in the absence of epidemics. The use of vaccines.

(2) Latent sepsis.—The value of vaccines prior to operation.

(3) Catarrh.— Inquiry into bacteriology and prophylactic use of vaccines.

(4) Typing of strains of diphtheria, cholera and dysentery bacilli encountered in different countries.

(5) The Schick reaction.

(6) Parallel testing of the Sigma and Wassermann reactions.

(7) Sand-fly fever.

These and other subjects have been explored in this collective way, with, in some instances, substantial and encouraging results. I need hardly add, especially in the present difficult times, that we cannot command success; a particular epidemic may dwindle and disappear, or the other material may not be forthcoming in sufficient quantity. More frequently, however, it is one of those inevitable but irritating "exigencies of the Service" which has called a premature halt to a promising line of inquiry. I trust, however, that such efforts may not be abandoned since these collective inquiries are of value not only because they multiply results and tend to accelerate progress, but because the work and results of one observer form a useful check on those of another. Again, the mere fact that workers at a distance from one another are engaged on the same problem and confronting the same difficulties stimulates inter-communication and tends to break down that feeling of isolation which may sometimes become so irksome when one is working alone.

Before leaving this subject, I would add that the method is capable of being of service to our civil brethren. There are many inquiries of medical, physiological, or sanitary importance which, because we are very busy people and because the problems are not perhaps of very direct military importance, we have not undertaken in the Services. At the same time, thanks to the favourable conditions of which I spoke at the beginning of my address, the Army, Navy, or Air Forces offer a field for their investigation under almost ideal conditions of observation and control. We have received, and continue to receive, so much ungrudging help and advice from our civil colleagues, that we should indeed be ungrateful if we did not in return do everything that we could to assist them, whenever this is within our power. I am glad to know that something has already been done for them in this way, and I hope that we may be able to do more.

As regards research and observation of the more strictly clinical character, I may add that, in the case of the Army, we have now the great advantage of the advice and controlling direction of our own Consulting Surgeon and Consulting Physician, and I am confident that their assistance and counsel would, if required, always be most readily available.

To conclude, I have been urging upon you that we should endeavour to secure a larger output of medical research from the Services, and have suggested that this is well within the power of many who have not so far embarked on it. I have done so for the following reasons. First, because it is our bounden duty to leave nothing undone which we can do to maintain or improve the health of the fighting forces, and to anticipate and prevent medical catastrophes in the future, not only by utilizing new knowledge, but by adding to it. Second, because I know nothing better calculated to maintain a man's professional interests as well as to keep him out of the grooves, which may become so dangerously deep as our Service advances. Finally, it is only by contributing our full share to medical progress that we can hope to maintain the high prestige gained for our respective Services by those who have gone before us.

SOME NOTES ON OLD-TIME LEPROSY IN ENGLAND AND IRELAND.

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(These Notes were begun as part of a proposed review, being in their inception a criticism of some historical matter in a recently published volume on Leprosy. But the discussion, a pleasant diversion from less congenial tasks, expanded until its primary purpose was lost sight of, and most of what follows—excepting the remarks on the English leper laws—has no direct reference to the original project.)

Since "Leprosy" will be a standard text for years to come, one would like to see the evidence regarding leprosy in mediæval Britain discussed more fully and in a more critical spirit. According to the authors, graphic records exist of the English leper laws, and they quote from Sir James Simpson a digest of these measures. Unfortunately no reference is given either to original statutes, or to the source of the authors' abstract.

Every statement in the summary is open to criticism, but in order to avoid undue tediousness, only a few points will be considered, namely, "Anyone found to be suffering from the disease was separated from his family, divorced, and his wife allowed to marry again." "He had to live outside the gates of a town." "He was regarded as dead by civil law." In spite of considerable expenditure of labour, I have failed to find any such decrees in the statutory law of England. They seem to me to comprise foreign enactments, ecclesiastical ordinances and resolutions, as well as excerpts from the rules of leper-hospitals which had no authority beyond their own gates.

As regards segregation—it is true that a person aggrieved by the presence of a leper, under certain conditions, could obtain the writ *De Leproso Amovendo* which directed his removal to a place apart. But the writ applied only to town-dwelling lepers who persisted in obtruding themselves on public assemblies. Further, it was rendered nugatory as the leper could not be removed if he undertook to remain in his house, where he would come into still more prolonged contact with his family, thus replacing a slight risk of contagion by a very real danger.

Obviously such a cumbrous and lengthy legal procedure could be undertaken in special cases only,[1] and the decree *De Leproso Amovendo* does not appear to have been in general operation at any period.[2]

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[1] See the curious inquisition concerning Johanna Nightyngale, of Brentwood, in Rymer's *Foedera* (1710 edition), Vol. XI, p. 635, Anno 1468. This woman, accused of "the foul infection of leprosy," refused to depart from the company of her neighbours, as directed, and appealed to Edward IV. She was examined under the King's warrant and found to be free from any blemish of leprosy.

[2] The form of this writ is given in the several editions of the *Natura Brevium* by FitzHerbert (a Judge of Henry VIII's reign), together with his commentary thereon. The latter is as follows: "The Writ *de Leproso amovendo* lieth, where

There was little real segregation, as we understand the term. Even the inmates of leper-hospitals systematically visited towns for the purpose of begging, and in certain localities they could exact toll of all corn and bread sold in the market, or, as in Shrewsbury, take a handful of corn from every sack offered for sale. The rules of the Sherburn leper-hospital[1] expressly permitted the lepers to receive their friends, and those coming from a distance were allowed to remain all night. It is illuminating to read in these same rules that a rebellious leper, whose contumacity yielded neither to flogging nor to a diet of bread and water, would receive the dread and final penalty of—*expulsion*! There is evidence, moreover, that lepers could refuse to submit to hospital isolation, and the great difficulty of finding "so many lepers" (i.e., six!) willing to lead a subjugated life is given as a reason for the shortage of patients in St. Julian's leper-hospital in 1344 (*quod vix seu raro inveniuntur tot leprosi volentes vitam ducere observantiis obligatam ad dictum hospitale concurrentes*[2]).

One severe mandate directed against lepers is that of 20 Edward III, 1346, which shows, incidentally, the unreality of the "absolute and strict segregation" to which Macnamara, quoted by the authors, attributes the eradication of the disease. This ordinance orders the withdrawal of all lepers then residing in London for the curious reason, stated in the (translated) preamble—"and some of them, endeavouring to contaminate others with that abominable blemish (that so, to their own wretched solace, they may have the more fellows in suffering) as well in the way of mutual communications, and by the contagion of their polluted breath, as by carnal intercourse with women in stews and other secret places, detestably frequenting the same, do so taint persons who are sound, both male and

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a Man is a Lazar or a Leper, and is dwelling in any Town, and he will come into the Church, or amongst his Neighbours where they are assembled, to talk with them, to their Annoyance and Disturbance,—then he or they may sue forth that Writ for to remove him from their Company. But it seemeth, if a Man be a Leper or a Lazar, and will keep himself within his House, and will not converse with his Neighbours, that then he shall not be moved out of his House. But there are divers Manners of Lepers; but it seemeth that the Writ is for those Lepers who appear to the Sight of all Men that they are Lepers by their Voice, and their Sores, and the Putrefaction of their Flesh, and by the Smell of them: But for those who are infected with that Disease in their Bodies, and it doth not appear outwardly upon their Bodies, *Quere*, whether such Writ lieth for to remove them." (8th Edition, p. 534.)

As regards these indications of "leprosy," it is noteworthy that the commentary was written subsequent to the great epidemic of the *Morbus Gallicus*—first definitely recorded for these islands, so far as I am aware, in 1497—and at a period long before the tertiary lesions of this disease were recognized as having any connexion with the earlier symptoms.

[1] Surtees, "Hist. and Antiq. of Co. Palatine of Durham," 1816, Vol, I, p. 129.

[2] Walsingham, *Gesta Abbatum Monasterii Sancti Albani* (Rolls ed.), Vol. II, p. 484.

female, to the great injury of the people dwelling in the city aforesaid, and the manifest peril of other persons to the same city resorting."[1]

It would be interesting to know what inspired this order of ejectment. Was it genuine concern for the public health, as stated, or was the decree merely a move in the age-long war of the authorities against the beggars, whose lawlessness and tumult constituted an intolerable nuisance to peaceable folk?[2] To quote the words of the Act of 1530, beggars are responsible for "contynuall theftes, murders, and other haynous offences, which displeased God, damaged the king's subjects, and disturbed the common weal of the realm." In the Middle Ages lepers, real or supposed, were allowed to beg, a privilege ordinarily denied to most under the heavy penalties of whipping, branding and even death, and this expulsion from London must have given welcome relief to the citizens, whatever the cause of its inception. We can be quite sure that not all the ejected were victims of leprosy, probably not even the majority. It is also likely that there was some proportion of impostors, for an imputation of leprosy provided the easiest means of livelihood then available for rogues and vagabonds.

"Anyone found suffering from the disease . . . was divorced and his wife allowed to marry again." If the law of the land recognized leprosy as severing the marriage tie, there would have been no necessity for two ecclesiastical leper-hospitals (Ilford, in Essex; and St. Julian, in St. Albans) to have included in their rules the respective provisions: "That no married leper be admitted unless his wife at the same time become a nun"[3]; and, "That those admitted be single persons, or, if married, to part by consent."[4] It is noteworthy that there is here no question of the wife's admission to hospital. Both these establishments were for men only: Ilford, founded some time in the twelfth century, having provision for thirteen; and St. Julian's, founded in 1135, for six.

Further, in a rather pathetic will, dated 1428, William Mannyng, a poor leper inmate of Monkbridge Hospital, makes the following disposal of his little property. Half a pound of wax (candles) to be burned over his body, sixpence to York Cathedral, sixpence to the monks of Knaresburgh, and "the residue to my wife, Agnes" (*residuum Agneti uxori meae*).[5] It is stated that Edgar, an Anglo-Saxon king of England, passed a law making leprosy a valid cause for divorce—doubtless incited thereto by the

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[1] For the full text of the mandate, in English, see Riley, T. H., "Memorials of London in the Thirteenth, Fourteenth and Fifteenth Centuries," p. 230, from which the above extract is taken.

[2] The ancient nursery rhyme, "Hark! Hark! the dogs do bark, The beggars are coming to town," was once something more than a meaningless jingle.

[3] [4] Dugdale, Sir W., *Monasticon Anglicanum* (1717 edition).

[5] *Testamentum Willielmi Mannyng Lazeri Domus de Munkbrig*, Will No. CCXCVIII in *Testamenta Eboracensia*, pts. 1 & 2; Surtees Society.

Venedotian and Dimetian Codes—but "leprosy" to the Anglo-Saxons may have meant anything. Judging from their chronicles, they did not distinguish even bubonic plague—recognized and named both on the continent and in Ireland—from other pestilences. The Plague of Justinian is not even mentioned in any English chronicle, and the great epidemic of 664, which we know from Irish sources to have been bubonic plague, is recorded, but unnamed. Thenceforth over several centuries we find a succession of nameless and unrecognizable epidemics, mainly ascribed to hunger, so that the "*Anglorum fames*" became a byword. The value of an early English diagnosis of leprosy may be imagined accordingly.[1] Edgar's law, whatever its implication, lapsed with the Norman Conquest, and here ended, so far as I can discover, the statutory recognition of leprosy as a cause for divorce in England.

"He was regarded as dead by civil law." As a condition of admission to certain lazar-houses, lepers had to take vows and submit themselves to whatever rules were laid down for their discipline. Various penalties were prescribed for breaches of these regulations, including expulsion in extreme cases. One of the articles of St. Julian's leper-hospital, St. Albans, dealt with wills, and directed that none of the brethren—i.e., the leprous inmates—might make a will "except by permission of the master" (of the hospital).[2] If lepers were dead in the eye of the civil law, they

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[1] Sir James Simpson says: "In these early times, the very words employed to designate the disease show its extent and severity," and instances an Old English phrase, "*seo mycle adl*" (the great ill), as signifying leprosy. He names several authors in support of this interpretation, but the number is immaterial as they all borrow from Somner's *Dict. Sax. Lat. Angl.* (1659). Here *seó micil ádl* is given as meaning "Elephantiasis the Leprosse, etc." The "etc." is suggestive. Somner's phrase, whatever its source, was not the common Old English term for leprosy, and is not included amongst the words for that disease in Ælfred's *Glossary*. The many references to leprosy—generally in a figurative sense—in Pope Gregory's *Pastoral Care* are rendered in the Old English translation by the usual derivatives and variants of *hreof*, which are also employed in the MS. on Leechcraft printed in the Rolls series. So too in the Gospels we have, Matt. viii. 3, —*And hys* hreofla *wæs hrædlice geclaénsod* ("And immediately his leprosy was cleansed" — *A.V.*); and, Mark i. 42 — *Sôna seo* hreofnes *him fram gewát* ("Immediately the leprosy departed from him" — *A.V.*). Just as in other languages, "*hreofla*," etc., included scab, ulcerations and other morbid conditions in addition to leprosy.

[2] "*Isti sunt articuli observandi inter Fratres professos Domus Sancti Juliani juxta Sanctum Albanum.*

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De Testamentis.

Nullus fratrum de caetero faciat testamentum, nisi de licentia magistri. Quod si aliter fecerit, pro nullo habeatur."—*Monast. Ang.* (1846 edition), Vol. VI, pt. 2, p. 619.

The later articles enacted by the Abbot Michael, 1344, include directions for the drawing up of wills, under the heading, *De forma testandi—Rubrica.—Gesta Abbatum*, Vol. II, p. 488.

could not have made wills, nor disposed of their property, and so there would have been no point whatever in requiring the inmates to assent to the rule given overleaf. The will of "William Mannyng, lazar," just quoted, is additional evidence on this point, since it was admitted for probate in the usual way.

With these remarks we may leave the question of the English leper laws, and proceed to a general consideration of leprosy in its historical aspect. Most of what follows has no direct reference to the volume which introduced this discussion.

It is very difficult nowadays to determine the approximate prevalence of leprosy in early times. That the disease existed is beyond doubt, but its importance was exaggerated out of recognition by ignorance, and the fifty biblical references to leprosy were a perpetual suggestion of an extensive involvement far removed from actuality. A maudlin sentiment, fostered by ecclesiastical teaching and example, regarded lepers as "Christ's poor," the earthly representatives of the beggar who was carried by the angels into Abraham's bosom, and of that other Lazarus whom Jesus is recorded as having loved and raised from the dead. The latter became the patron saint of lepers by a series of gradations which illustrate the disordered workings of the early monkish imagination. Needless to say, there is no scriptural record that either the symbolical beggar of Christ's parable, or the real Lazarus of Bethany, suffered from leprosy. But this biblical reticence helped rather than hindered diagnosis. The beggar was *ulcerosus*, full of sores, which then suggested leprosy only.[1] The nature of the infliction thus satisfactorily determined, the beggar's name, Lazarus (which merely means, "Helped of God"), was identified with his supposed disease, and "lazarus" or "lazar" became synonymous with "leper." The diagnosis of the saint's ailment is now rendered simple. Since he was called "Lazarus," clearly he must have been a leper, and who more suited than he to be their patron saint! And the general conception of mediæval leprosy is based mainly on indefinite and unsupported testimony of men who could think and argue along lines like these.

Since much of the evidence adduced by medical and other writers is of the nature of mere textual mention of terms for the disease, it is well to consider what the chroniclers meant by "*lepra*," and its derivatives. First, these words were used in the restricted sense of leprosy, and of what was believed to be such. Making every allowance for habitual plagiarism, and omitting much that is unintelligible, the writings of several early continental physicians show evidence of first-hand acquaintance with leprosy. But Gordonius' precepts—judging by his protests not always followed by

[1] It is hardly necessary to add that the boils which afflicted the patriarch Job were similarly identified. In a context which proves the specific signification of "*lepra*," the *Gesta Abbatum* has ". . . *revocantes ad memoriam beati Job, qui cum percussus esset lepra.*"—Vol. II, p. 503.

those whom he addressed [1]—are no mirror of the practice obtaining in mediæval England. Perforce the diagnosis was often decided by monks, overseers, or even by watchmen at some city gate. If these functionaries were to carry out a leper-hunt in an English hospital to-day, they would not come away empty-handed, and mediæval "lepers" doubtless included a mixed assortment of sufferers from various skin diseases, ulcers, tumours and deformities. But we have no evidence regarding the relative proportions of the true lepers, and the supposed, since most of the records are mere assertions of "leprosy," with nothing in the context to indicate the true nature of the ailment. Sometimes, however, we find an account of some unquestioned "leper," embellished with clinical details which prove the writer's undoing, for they suffice to show that the diagnosis given so complacently was absolutely wrong. The sad case of Marjory Bysseth in Elgin will bear repetition.[2] This unfortunate old woman was charged with witchcraft by certain friars on the grounds that she had repeated her prayers backwards, and had transformed herself into a hare. To her tears and prayers of, "Pitie! Pitie! I am guiltless of ye fausse crymes, never sae much as thought of by mie," was added the evidence of a parish official who testified to her known good character. But suddenly the favourable atmosphere of the inquiry changed. A "Leper" came running from the neighbouring lazar-house, and passing through the crowd, he "bared his hand and his haill airm, ye which was wythered and covered over with scurfs, most pyteous to behold, and he said, 'At ye day of Pentecost last past, thys womyan did give unto me ane shell of oyntment, with ye which I annoynted my hand to cure ane imposthume [abscess] which had cum over it, and beholde, from that day furthe untyll thys, it hath shrunk and whythered as you see it now.' . . . But ye said Marjory Bysseth cried pyteously, that God had forsaken her, that she meanyed gude only and not evil." But all this availed her nothing, since she had smitten a man with "leprosy." Thereupon the poor old creature was dragged "amid mony tears and cryes to ye pool . . . and soe they plonge her in ye water. And quhen as she went down in ye water, there was ane gret shoute; but as she rose agayne and raised up her arms, as gif [if] she wod have cum up, there was silence for ane space, when agane she gaed doune with ane bubblinge noise, and they shouted finallie—'to Sathan's kyngdome she hath gane,' and forthwith went their wayes."

Again, we find "leprosy" mentioned in some context which prevents any exact interpretation of the word. The great pandemic of plague, long afterwards named "The Black Death," broke out in England in August, 1348, and raged there until the end of 1349. Scotland escaped

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[1] "Lepers at the present day are very injudiciously diagnosed. Whoever therefore has ears, let him heed this, if he will."

[2] "Topographical, Statistical and Historical Gazetteer of Scotland," 1842, Vol. I, p. 494.

in the main until 1350. In 1349, when England was prostrated by the weight of the epidemic, the "exulting Scots" assembled an army in Selkirk Forest in preparation for a massed assault on the stricken foe. But plague, spreading slowly northwards, broke out in the Scottish army and about 5,000 of the troops died, a disaster which effectively cooled their warlike ardour. In the contemporary *Chronicon Galfridi le Baker*, this outbreak—recognized as plague at the time—is called "*lepra*." The writer was quite familiar with the buboes, hæmorrhages, and other plague signs, and enumerates them on the same page of his chronicle. Obviously he employs *lepra* as a general term for "affliction," just as both St. Jerome and John Wyclif apply the epithet "leprous" to Christ, or at any rate in a passage which they believed to foretell Christ's sufferings on earth.[1] But when Hubert de Burg, in a tirade against Henry III, declares wildly that he squints, is a craven, has "a kind of leprosy" (*speciem leprae*), and so on, forthwith Henry of England is pronounced a leper! Then what of Le Baker's Scots and the earthly Christ? The translators of King James's Bible, with an understanding of ancient usage foreign to modern verbalists, rendered St. Jerome's *leprosus* by "stricken." Even a more comprehensive employment of this word is found in the pages of the older writers where, for example, we are told that "Myst and fog . . . make the graine leprous," and are warned that "Olde beefe . . . doth engender melancolye and leporouse humours."

The English noun "leprosy," like its Latin equivalent, had a similar variety of meanings, and amongst others was ordinarily applied to mange in animals.[2] It is worth considering, further, what "leprosy" would have meant to an Irish scribe, since the earliest references to leprosy in these islands are cited from Irish sources. This point is important also, for many of the early English clerics studied in Ireland, then the chief centre of learning in Western Europe. The Erse words were as comprehensive as the English and Latin. *Lobhar* could mean not only a leper, but also a person afflicted with various distempers, and could even be used for one who was merely of a delicate and wretched appearance. *Clam* (modern *claimhe*), another word for leprosy, could also mean scurvy, and like the English "leprosy" was commonly used for mange in animals.

Yet in spite of all this inexactness, vague and undefined mention of

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(1) Isaiah, liii.

(2) Blundevil, *The Order of curing Horses diseases* (1580 ed.): "The cankred mangenesse, most commonlie called of the old writers the Leprosie."—Ch. III, 2.

Sir James Simpson stresses the substitution of "*Elephantuosi*" for the usual "*Leprosi*" in a mediæval MS. reference to lepers. He considers this "very striking exception" as "confirmatory" of his opinion that those styled "*Leprosi*" suffered from the elephantiasis of the Greeks, i.e., true leprosy. Unfortunately for this argument, the main title of the chapter (cliiii) on Mange in the treatise on Horses' Diseases just mentioned, is, "The Leprosie or uniuersall manginesse, called of the old writers *Elephantia*."

"leprosy" is accepted as though purged and snuffed from ambiguity, and the equivalent of precise scientific usage.

Not only are we misled by subscribers to the doctrine of plenary verbal inspiration, but there is further darkening of counsel by seekers after leprosy whose assertions are not supported, even verbally, by the texts they cite. Newman[1] says of Ireland in the 6th Century, "It seems there was (what was termed) a pestilence of leprosy." As evidence of this he gives a reference to the *Chronicum Scotorum*, A.D. 550. Under this year the *Chronicum* has no entry of leprosy or any other disease, but a *Mortalitas magna* is recorded for the succeeding year, 551. This portion of the *Chronicum* is written in Latin with occasional explanatory interpolations in Erse. Regarding this *mortalitas* the scribe was at pains to insert two such glosses, one in the text and one in the margin, so that there may be no possible misunderstanding of the nature of the disease. The glosses are, respectively, "i. *an Crom Conaill*," and "i. *in Buidi Conaill*." These are both archaic Erse for Bubonic Plague, and are the terms commonly employed by the Irish annalists for the Plague of Justinian, of which the outbreak noted in the *Chronicum Scotorum* was an extension.

This allegation of extensive leprosy in the 6th Century is brought forward also by Belcher,[2] and it is curious that he, too, gives his authority as the *Chronicum Scotorum*, A.D. 550. He adds in English what is stated to be an extract from the chronicle for that year, as follows: "The pestilence which is called *samtrusg*, the mange, scurvy, or leprosy, raged this year." This is obviously intended for the entry of the year 554, which reads in the original, "*Pestis quae uocatur* samtrusg." That is all. The gloss of *samtrusg* by "mange, scurvy or leprosy" is an addition by Belcher. The identity of the ailment called "*samtrusg*" in old Erse cannot be determined with certainty. It was some disease which appeared in epidemic form, and reached such proportions that its occurrence in several instances was the only event noted by a chronicler for the year. From a gloss appearing in one text, there appears to have been some obvious skin manifestation. Whatever *samtrusg* may have been, certainly it was not leprosy.

When we are asked to accept the theory of early widespread leprosy in Ireland, and by implication in England too, supported by evidence like the foregoing, there is a struggle between laughter and tears.

An examination of the question of mediæval leper-hospitals and lazar-houses discloses similar exaggeration and special pleading. Lists of over a hundred leper-houses have been compiled by Simpson[3] and others, and the simple-minded reader will be duly impressed by these imposing arrays. But

[1] Newman, G., "Leprosy," New Syd. Soc., p. 27.

[2] Belcher, *Dublin Quart. Journ. of Med. Science*, 1868, p. 36.

[3] Simpson, Sir James Y., *Edinburgh Med. and Surg. Journ.* (three papers), 1841-42.

if he troubles himself to look up such records[1] as still exist, the charters, where known, the reports of inquisitions, visitations and so forth, he will find his faith somewhat shaken, and will view with suspicion claims made for establishments where similar documentary evidence cannot be produced.

Some of the alleged "leper-hospitals" were alms-houses, pure and simple, like that of St. John, in Aylesbury, established for the relief of the sick and poor of that town (*ad sustentandum infirmos et degentes ejusdem villae*).

Others were leper-houses only in part, and even then, frequently the *leprosi* constituted but a minority of the establishment. At an uncertain date before his death, which occurred in 1139, Thurstan, Archbishop of York, established a hospital at Ripon, "for the relief of all the lepers born in Richmondshire" (*ad sustentandum omnes leprosos in Ripschire procreatos et genitos*). The endowment provided for eighteen patients, but even this modest allotment for "all the lepers of Richmondshire" was not reserved exclusively for them, the poor having an equal claim for relief (*ad sublevamentum tam pauperum quam leprosum*). Ripon leper-hospital was empty of lepers at the time of Edward III's commission (1341). In Henry VIII's reign the same state of affairs is recorded, the hospital then containing two priests "and five pore people," appointed to pray for all "christen sowlez." Petrus Capellanus established St. Mary Magdalene's at Lynn, in 1145, with provision for a prior, nine sound brethren and three leprous. I have not found any later account of this foundation, but if such exists, one might hazard a prophecy of a metamorphosis of the three leprous brethren to three whole brethren. At Oxford, St. Bartholomew's was endowed some time during the reign of Henry I (1100-35), for a master, a clerk, two whole brethren, and six leprous or infirm brethren. But there were no leprous brethren in St. Bartholomew's at the date of Edward III's inquisition.

Again, hospitals established explicitly for lepers only might be alienated to other purposes, for one reason or another, but often because the required lepers were not forthcoming. King John's lazar-house at Stourbridge was applied to other purposes within fifty years of its foundation.

Twenty-five leprous sisters, a master, prioress, and three priests were provided for in St. James's near Canterbury, founded in 1189. But Edward III's commissioners found St. James's occupied by twenty-five whole sisters.

Adam de Cherryng founded a leper-house in Romney, Kent, about 1190, for an unstated number of lepers, probably very few as the establishment included only one priest. In 1363 the hospital is reported as "derelict and totally desolate," "chiefly because no lepers were found, nor for long

[1] Most of the historical notes on the English leper-hospitals, following hereon, are taken from the various charters, depositions, and so forth, which appear in the *Monasticon Anglicanum*, *Gesta Abbatum*, and Bishop Tanner's *Notitia Monastica*.

times past could any be discovered" (*eo maxime quod nulli leprosi reperiebantur nec longis temporibus retroactis potuerunt reperiri*). In this year, 1363, John Frauncys received a charter for a new foundation, providing for one master and one priest, the fruitless quest for lepers having been abandoned.

Reference was made in an earlier part of these notes to the rules of three leper-houses, Ilford, St. Julian's, and Sherburn, and something in consequence should be said of their subsequent history. St. Thomas's, at Ilford in Essex, was founded by Adeliza, Abbess of Berking, at an uncertain date during the twelfth century, for the support of three clerics and thirteen poor lepers. Edward VI's commissioners found it empty of lepers: "The Hospitall ther ffounded to find 13 pore men being lepers 2 Pryests and one Clerke whereof there is at this Daye but one Priest and 2 pore men." The second of these three, St. Julian's, had also a clerical founder, Jeffreys, Abbot of St. Albans, and was endowed for six lepers in 1135. It is recorded in 1344 that the revenues of St. Julian's are too large for its needs, the accommodation not being in demand. "Clearly in general there are not above three (patients), occasionally two, and sometimes only one" (*videlicet, unus tantum, aliquando duo, et, ut communiter nonnisi tres*). The last, Sherburn near Durham, the largest leper-hospital in England, had as founder Bishop Pudsey of Durham, "the joly Byshop," as Lambarde calls him. It was built in 1184 to accommodate the, then, enormous number of sixty-five patients, both male and female, together with a prior and prioress, three priests and four other clerics. Nothing is known of the history of Sherburn for over a hundred years, during which time we may assume, if we will, that the allotted number of lepers remained in enjoyment of the "joly Byshop's" charity. We next hear of Sherburn when its charter was confirmed by Bishop Kellaw, with the direction that the constitution should be ever thereafter observed inviolably. Even if the terms of the original charter had been "observed inviolably," certainly those of the confirmation were not, and finally the abuses and threatened ruin of the hospital were brought to the notice of the pope. In 1434, Bishop Langley promulgated new regulations for the better government of the hospital. Instead of the sixty-five lepers, the master was now charged with the "maintenance of thirteen poor brethren and of two lepers," and regarding these latter there is the suggestive proviso—"if they can be found in these parts" (*si in partibus reperiri possunt*). Which is the last heard of leprosy in the Sherburn leper-hospital. The inference of the addendum is obvious, and it is hardly necessary to quote the evidence on this point given at a later inquiry, "and that ther cowlde not so many Laiseris be found in that part of England." In 1557, the charge was increased to "8 poore men and women, 4 Chaplens, 2 Deacons and 4 Choristers." The later history of the foundation may be given in part, as it typifies the fate of so many of the "leper-hospitals:" "After this there is another Translac͡on obtened by one

Mr. Decar, and by that all the sixteene poor people were utterly expelled; and in their place two preests, two Diacons and fower Children: so that by this Translac͡on there should be six preests, six Diacons and six Queresters. But is there neither poor man, nor poor woman, neither yet Priest nor Clerk, nor Child found of the Howse charge; saving only two priests, two Clerks, and two Children. . . . And all the residue of the Revenues of the Howse, being only poor men's Livings, goeth all together, to the private use of the Master."[1]

It is hoped that the foregoing evidence proves that no alleged leper-hospital can be accepted as such in the absence of definite information regarding its original destination, and, further, some knowledge of the after-history of the foundation is essential. The mere label "leper-hospital" attached to an institution is no proof that it ever contained a single leper. Yet some establishments are claimed to have been lazar-houses on no better evidence than a gossiping remark by some writer, perhaps years after the supposed leper-hospital had ceased to exist. That there were, as stated, 2,000 leper-houses in mediæval France is, to me, absolutely incredible. If 2,000 leper-hospitals existed there, what was the number of ordinary hospitals (including hospices and alms-houses), convents, chantries, and so forth? The total must have run into six figures.[2]

To return to the extent of leprosy in England in the Middle Ages. I believe Creighton[3] gives a reasonable estimate of the prevalence of this disease, at its worst, when he says: "There might have been a leper in a village here and there, one or two in a market town, a dozen or more in a city, a score or so in a whole diocese. Thus in the records of the city of Gloucester, under date 20 October, 1273, three persons are mentioned by name—a man and two women—as being leprous and as dwelling within the town to the great hurt and prejudice of the inhabitants." To assert, like one distinguished historian, that leprosy in mediæval England was a more terrible scourge than plague, is nothing short of ludicrous.

However tedious these notes may seem to the reader, they cannot conclude without mention of the famed Armagh leper-hospital, for it epitomizes much that passes as historical evidence regarding leprosy. This establishment finds an honoured place in the tables of such foundations, and in view of its antiquity often heads the list. Newman says: "The earliest notice of a leper-hospital in Ireland was in 869, when the hospital flourishing at Armagh was demolished and sacked during Arlaf's invasion."[4]

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[1] MS. quoted by Surtees, *loc. cit.*

[2] Carlisle, N., in "An Historical Account of the Origin of the Commission," etc., gives the number of English Monastic foundations suppressed by Henry VIII as: 645 Convents; 90 Colleges; 2,374 Chantries and Free Chapels; and 110 Hospitals.

[3] Creighton, C., in H. D. Traill's "Social Life in England," 1893, Vol. I.

[4] Newman, *loc. cit.*

There is no evidence of any leper-hospital at Armagh, flourishing or otherwise, so far as I can discover. No such foundation is mentioned in the *Monasticum Hibernicum*, nor in any of the chronicles where I have found the destruction of Armagh by the Danes recorded.[1] But the mystery seems to be solved at last: Once clear of the maze of cross-copying from book to book, all statements regarding this foundation are ultimately traceable back to Belcher,[2] who cites the *Annals of Innisfallen* as his authority. He obviously used the Latin translation of these Annals (of which more anon), where the entry relative to the sack of Armagh reads: "*Vastatio Ardmachae per Amlafum, ita ut combusta esset Civitas cum suis domibus et Nosocomiis.*" Then follows the number of the slain. Belcher does not reproduce the Latin, but gives a translation, as follows: "Devastation of Ardmagh by Arlaf so that the city was burned with its houses and hospitals (*nosocomiis* or leper-houses)." In the Latin there is not a single word about lepers from beginning to end, the gloss "leper-houses" being a distraction of Belcher's own imagination. *Nosocomium* is *hospital*, neither more nor less, and Belcher could have translated the word by "Hospital for Diseases of the Chest" with as much justification as by "leper-house."

But the end is not yet. The *Annals of Innisfallen*, cited by Belcher, is one of a number of ancient Irish historical texts translated into Latin by Dr. Charles O'Conor.[3] To his stupendous task of collating, annotating and translating these annals, O'Conor brought wide learning and tireless

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[1] *Annals of the Four Masters; Annals of Ulster; Chronicum Scotorum; Annals of Innisfallen; Annals of Clonmacnoise; Fragmenta Annalium Hiberniae.*

[2] Belcher, *loc. cit.*

[3] Charles O'Conor, D.D., in 1798 was appointed chaplain to the Marchioness of Buckingham, and librarian at Stowe. Between 1814 and 1826 he published the four large volumes of his monumental work, "*Rerum Hibernicarum Scriptores Veretes.*" Only 200 copies were printed, the cost of publication, £3,000, being borne by the Duke of Buckingham. "The text of the 'Annals' published by O'Conor . . . was for the time a useful addition to the materials for the study of Irish history. . . But, by the unanimous opinion of experts since the date of publication, O'Conor has been pronounced incompetent for the task he undertook."—(Dict. Nat. Biog.) Dr. O'Conor was a grandson of O'Conor of Balanagare, who is now best known, perhaps, as the recipient of the two letters from Dr. Johnson, addressed under the style, "Charles O'Conor, Esq.," which are printed in Boswell's "Life." A profound Celtic scholar, O'Conor of Balanagare was said to be the only person then living who could interpret the technicalities of the ancient Brehon Laws. Unfortunately he was handicapped by deficient general learning, the result of youthful poverty caused by confiscation of the family estates. Later, portions of the Balanagare property were restored by the commissioners of the confiscated estates, and the kindly scholar was able to pursue his studies in comfort and affluence. If the two O'Conors could have collaborated, each would have counterbalanced the other's deficiencies, the elder possessing the necessary Celtic learning, and the younger, wide general scholarship. In 1820, the then O'Conor of Balanagare succeeded to the title of O'Conor Don which is borne by the blood representative of King Roderic O'Conor, last Monarch of Ireland.

patience. But the interpretation of the archaic language and obsolete syntax of the manuscripts, obscured still further by a maze of contractions, called for a degree of exact and specialized scholarship which O'Conor did not possess. And as an unfortunate result of his shortcomings, the Latin translations cannot be relied on as necessarily expressing the meaning of the Irish text. If we compare the original entry[1] describing the sack of Armagh in 869, with O'Conor's Latin translation, we find another of his errors, which I have not seen noted before: "*Derthightibh*," which he translates by "*nosocomiis*," has no connexion of any sort or kind with *hospitals*. It is merely the dative plural of the word for *oratory*. And so begins the legend of the Armagh leper-hospital! O'Conor, misunderstanding the original text, transforms *oratories* into *hospitals*. Belcher gilds the lily, and the hospitals become *leper-houses*. And the necessity for such foundations is adduced and accepted as valid evidence of the contemporary prevalence of leprosy.

O, History! what crimes are committed in thy name!

Rites are not wanting which may bring repose to the perturbed spirits of the dead. It is said there was even a special ritual for the restless souls of those poor little children who never lived. Perhaps it might serve to lay the weary ghost of this leper-house which never existed.

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[1] "*Argain Ardmacha le h Amhlaoibh gur loisgeadh an baile gona tighthibh 7 gona derthightibh.*"

Several other chronicles specifically mention the destruction of the oratories. "... *coroloscadh cona derthaigibh*" (Annals of Ulster); "... *do losccadh co na dearthaighibh uile*" (Four Masters); etc. These structures, so famous under their nosocomial disguise, seem to have constituted one large monastery, for in the *Frag. Ann. Hib.* the scribe inserts the textual note, "... oratories, i.e. the great oratory of Mac Andaige" (... *derrtighibh. i. derthach mór mic Andaige*).

A PHYSIOLOGICAL METHOD OF TREATMENT FOR THE COMMON INJURIES MET WITH IN THE REGION OF THE KNEE-JOINT.

By Captain R. GASTON ATKINS, M.C.
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Every medical officer must be familiar with the soldier who has some abnormal condition of the knee-joint which interferes with the full execution of his duties.

Such cases are often rather indiscriminately diagnosed as "Internal Derangement of the Knee-joint." This is used by some to denote a definite injury to the semilunar cartilage, while others use it for that type of case which has had many attacks of synovitis of the joint, the exact cause not being specified. The expression is a bad one, as many different conditions may produce an internal derangement of the joint, while the common causes of "chronic" knees are extra-articular.

The importance of a correct diagnosis in all cases of injury around the knee cannot be overestimated, that is, if we are to return the man to duty in as short a space of time as is compatible with making the knee as fit as it was prior to the injury.

Clinically these cases present many difficulties, as the symptoms of any injury to the knee (otherwise than severe trauma) are practically the same. A good knowledge of the anatomy of the joint, plus an accurate history of the injury, or if the knee has been previously injured, of all these injuries, is essential in making an accurate diagnosis; as is also a careful clinical examination. This latter may often with advantage be carried out under anæsthesia.

Durin the last phase of the Great War some three hundred cases came under my care. These men had all been marked "Permanent Base" with chronic synovitis of the knee. To show that the majority of these cases are curable, and also to show how many of them could have been prevented from becoming chronic, is the object of this paper.

The integrity of the knee-joint depends on the normal condition of its ligaments. These are so placed as to prevent abnormal movement, and are sufficiently strong to compose practically the whole strength of the joint. The muscles controlling the joint exert their pull in a direction opposed to abnormal movement, and so, by relieving the ligaments of a certain amount of strain, are valuable aids in strengthening the joint. It follows from this that if from any cause the muscles are lacking in tone, or there is any loss of control over these muscles, the ligaments are more likely to be injured and the joint so much the weaker.

It has been already mentioned that all injuries produce a common set of symptoms. These are :—

(1) Hyperæmia and swelling of the synovial membrane and increased local temperature.

(2) Increased fluid is excreted into the joint (this is not a normal synovial fluid. It is pathological inasmuch as the relative amounts of albumin and globulin are altered. The salt-content is also altered).

(3) Atrophy of the muscles controlling the joint. In this case the knee extensors are chiefly affected, the extensor fascia femoris is also involved, but to a less degree. This is a reflex atrophy, and occurs in the muscles around any injured joint. It is the first symptom to appear and the last to disappear. To mention that it has been proved that this atrophy commences within a few hours of the receipt of the injury, and also that in

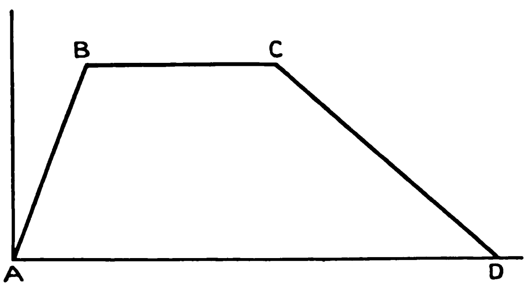

FIG. 1.—A voluntary contraction in a normal case rises sharply, A– B ; that is, the muscle responds at once to a cortical stimulus ; the top of the contraction curve can be maintained, B–C, and finally relaxation is gradual, C—D ; that is, the muscle is under complete control.

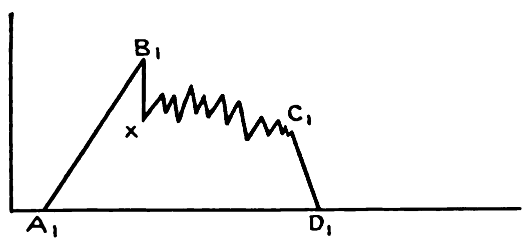

FIG. 2.—A voluntary contraction in the case of an atrophied vastus internus does not rise so sharply or as high as in the normal A_1—B_1 ; that is, the muscle response to a critical stimulus is slow and a poor contraction only is elicited ; there is a sudden drop, B_1 ×, i.e., the muscle goes out of control ; the remaining contractions are jerky and irregular, the top of the contraction curve cannot be maintained, B_1—C_1, and finally, relaxation is out of control and the contraction gradually peters out, C_1—D_1.

chronic disease of the knee the atrophy can be traced as far as the cells of the cerebral cortex is to emphasize the importance of this symptom.

Figs. 1 and 2, which are diagrammatic, show the effect of this atrophy on muscle function, and were obtained by recording the contraction produced by a normal vastus internus on a Marie's tambour, and contrasting it with that produced by a vastus internus atrophied as a result of a "chronic" knee.

From this we see that no case can be considered as cured until the extensor group of muscles is again working efficiently. This can be established by clinical observation and measurement.

If the muscles are not normal before the knee is again subjected to strains the ligaments are deprived of a valuable source of protection. Many cases of recurring synovitis are seen in such cases as a result of slight trauma, and owing to the neglect of this point each fresh trauma increases the atrophy, and so a vicious circle is established.

The object of treatment is to break the vicious circle, and the obvious point of attack is the muscles. Equally with this any strained or overstretched ligament must be brought back to normal. To do this the particular structure must be treated in the "corrected" position, which is, in the case of a ligament, extension on a back-splint; or in the case of a strain of a tendon, or any injury associated with the popliteus muscle, in a position of slight flexion; plus surgical rest. If one of the semilunar cartilages is injured, the leg must also be treated in extension to allow the torn structures to become firmly united if possible. Injuries to the cartilages occur only secondarily to strains of the corresponding ligament, and in any case these ligaments must be efficiently treated.

The diagnosis of each lesion must be clearly established before commencing treatment. If the knee has never been injured previously the diagnosis is simplified, as seldom, if ever, can a true history of previous injuries be given by the patient. A definite history of locking is diagnostic of an injury to one of the semilunar cartilages, but an apparent locking is sometimes seen. This condition must be recognized. If the knee becomes flexed and *slowly* becomes straight no injury to the cartilages has happened. The word *sudden* is intimately connected with the diagnosis of an injured cartilage. If no locking occurs it does not imply that the cartilage has escaped. An injured cartilage will very often become firmly bedded down again and give no further trouble. It is only in those cases in which the cartilage is loose and continually giving trouble that operation for its removal should be resorted to.

Points of tenderness around the knee show us which particular structure is injured. A strain of the internal lateral ligament is the commonest injury seen in this region, and next in importance is a strain of one of the slips of insertion of the biceps tendon. It is only rarely that the external lateral ligament is injured. This can be easily ascertained by imposing a strain on this ligament; if this is injured stretching it will cause pain. Cases are met with which have pain internal and deep to the biceps tendon and in which there is no damage to the external lateral ligament. The cause is obscure, but as there is a certain definite area of tenderness it is possible that there is some injury to the popliteus or its associated bursæ.

In order to bring the joint back to normal we have to: (1) get rid of the fluid in the joint; (2) cause repair to take place in any injured structure; (3) bring back full power of control over the extensor group of

muscles ; this latter implies (*a*) building up the muscles and (*b*) re-education of the same.

As regards (1), the fluid can only be absorbed from the joint at the same rate as the overstretched fibrous capsule returns to normal. It is important that this fluid should be got rid of quickly, for as long as there is tension in the joint, little if any impression will be made on the muscles. Occasionally one sees a case where the fluid in the joint refuses to absorb. As soon as this is recognized the joint should be aspirated.

If we have at our disposal a treatment which will overcome each of the three disabilities just mentioned at the same time, we should be able to cure our cases.

If we produce as big an active blood-supply around the joint as is possible, the fluid will in most cases be rapidly absorbed, repair to any damaged structure will take place rapidly and the muscles will be got into as healthy a state as possible.

I especially mention an increase in the active as opposed to the passive blood-supply, such as that produced by counter-irritants. I believe these latter to be bad, as the congestion produced tends to soften and weaken the ligamentous structures around the joint, which is the opposite to what we wish to do. Incidentally treatment by counter-irritants postpones massage.

To bring about this increase in the blood-supply the muscles around the joint must be exercised, as the arteries of any structure on which rest is enforced diminish in calibre, in which case the blood-supply will be diminished. At the same time the leg must be treated in the "corrected" position, which in all cases involves surgical rest. Muscular action must, therefore, be obtained without at the same time producing joint action. This can easily be done by means of contractions produced by an electrical stimulus—that produced by a Bristow coil is the best, as a graduated contraction is obtained. In those cases in which owing to the amount of atrophy present no voluntary contraction of the extensor group can be produced, an electrical stimulus of some form is essential in the early stages of treatment. Later, when a voluntary contraction can be produced we can discard artificial stimuli, as with the voluntary stimulus we are at the same time re-educating the muscles.

A very valuable method of stimulating the circulation is by means of contrast baths of hot and cold water. I use these baths extensively. They have a marked influence on the rate of absorption of fluid from the joint. At the same time any local infiltration of any injured structure is absorbed more rapidly, fibrous structures are toned up and the musculature is increased.

These baths must be used with certain precautions. At the commencement of treatment they must not be used for too long a time at any one sitting. Five minutes twice daily is ample, at the end of three or four days the time may be doubled ; it should never exceed fifteen minutes. A

large area of the thigh and leg must be included, the baths must not merely be applied to the knee. If these precautions are not observed a passive congestion only will be produced and not an increase in the active blood-supply, which is what we desire. Massage is also used as a means to this end.

To aid the absorption of fluid from the joint, a tight bandage is applied to the knee for the three or four hours following this treatment.

The exercises which the patient performs are as follows: He contracts the extensor group with the knee in the extended position, this produces an upward lift of the patella. The large mass of muscle on the posterior aspect of the joint must also be exercised. To do this the patient is instructed to place the sole of the foot of the same side as the injured knee on the dorsum of the sound foot, he then forces down the good foot into a position of plantar flexion by contracting the calf-muscles of the injured leg, using as a resistance the dorsiflexors of the sound ankle.

By these means, outlined above, we produce a great increase in the active blood-supply around the joint and as a result we see a rapid disappearance of all symptoms. In cases of injury to ligaments a back-splint is used for ten days or such time as any local tenderness remains. The patient is kept in bed until all the fluid has disappeared from the joint. If there is a definite injury to the cartilage, after the knee has been straightened the back-splint is worn for a month—this allows he cartilage to become rebedded if it is at all possible for it to become so.

In chronic cases where any abnormal movement is present the splint is also worn for a long time; as if it is possible for the ligaments to retract to normal they must never be subjected to any strain during treatment.

In all chronic cases the knee should be put through its complete range of movement with the patient anæsthetized. This also applies to any recent case which appears to be slow in getting better. Small adhesions do form which retard the cure, and it is essential that these be broken down.

In cases which show a strain of a tendon at its insertion treatment must be given with the knee slightly flexed, and when the patient is allowed up the heel of the boot should be slightly raised. This position must also be adopted for any injury to the infrapatella pad of fat, as when this structure is enlarged it may be nipped in the position of full extension.

No case should be sent back to duty until the muscles are normal. This often takes some time, but it is not time wasted. If a case that has been discharged as cured be readmitted to hospital, either the injury is entirely a fresh one and has no connexion with the previous injury, or else there is some definite injury to the cartilage, a loose body is present, or there is a hypertrophy of the synovial membrane in the form of synovial fringes. All these latter conditions demand operation.

I believe that if the treatment is carried out, the number of cases of readmissions to hospital or recurring injuries to the knee will diminish

and the accident of a dislocated cartilage will be realized to be less frequent than it is supposed to be.

In my experience cases of injury to the knee make up a very large proportion of all surgical cases admitted to hospital, and it is presumed that the same occurs at all hospitals. If this is so, it shows that the present-day methods of treatment of these injuries should be improved. Therefore any rational treatment might with advantage be given a fair trial.

I should be very pleased if anyone who is sufficiently interested in this type of case to give a trial to the treatment outlined above, would let me know his results to c/o Glyn, Mills and Co.

FURTHER INVESTIGATION INTO THE STERILIZATION OF WATER BY CHLORINE AND SOME OF ITS COMPOUNDS.

By Major C. H. H. HAROLD.

Royal Army Medical Corps.

"There is no safe method of preventing water-borne diseases except sterilization of the liquid."

—Rideal.

Part II.—New Series.

EPITOME OF EXPERIMENTS.

Part II.—Tank and Laboratory Experiments

(*Continued from p.* 363.)

Series N.

(1) At Race's suggestion, various chlorine and ammonia combinations were treated with certain solvents. As it was thought that the solubilities of these might be affected by varying concentration, a constant of 25 parts per million was adhered to.

20 c.c. of the solution were shaken up with 20 c.c. of CCl_4, the water residue and CCl_4 solution titrated in 500 c.c. of water gave the following results:—

	CCl_4	Water residue	Total
Hypochlorous acid	0·2	0 8	1·0
Bleach	Trace	1·5	1·5
Ammonium hypochlorite (made by double decomposition)	Trace	1·5	1·5
Equivalents of Cl_2 and NH_3	0·4	1·2	1·6
Equivalent of Cl_2 and ½ equivalent of NH_3 ..	1·3	0·2	1·5
Cl_2	0	0·7	0·7

It appears that certain specific differences in solubility in CCl_4 exist.

(2) Repeat using equivalents of Cl_2 and NH_3, and an equivalent of Cl^2 and ½ equivalent of NH_3. Procedure as in (1), but using 50 c.c. of solution and CCl_4.

	CCl_4		Water residue		Total
Cl_2	Nil		1·5		1·5 about 50 per cent loss
Titration in water, 300 c.c. .. .. .. =	2·5 0	2·5			
1 Cl_2 + ½ NH_3 (equivalents)	0·3 0	0·3	2·3 0·2	2·5	2·8
Titration in water, 300 c.c. .. .. .. =	2·5 0·7	3·2			
1 Cl_2 + ½ NH_3 (Cl_2 equivalent + ½ equivalent NH_3) =	0 2·2	2·2	0 2 0	2·0	4·2
Titration in water 300 c.c. .. .. .. =	0·2 3·8	4			

Again similar differences appear, but in addition it is noted that a proportion of second fraction may be found both in water residue and in CCl_4. The mixture of equivalents provides little CCl_4 soluble compound.

(3) A comparison of solubility of combinations in a concentration of 25 p.p.m. All compounds left in flasks under covers on bench for four hours to ensure stability, using 20 c.c. of solution for extraction and titration.

	Solvent		Water residue		Total
Cl_2	CCl_4 Nil		0·7 0		0·7
	CS_2 Nil		0·7 0		0·7
20 c.c. titrated in 500 c.c. water ..	1·1 0	1·1			
1 Cl_2 + ½ NH_3 = 1 equivalent Cl_2 + ½ equivalent of NH	CCl_4 0 0·7		0 0·8		1·5
	CS_2 0 0·9		0 0·6		1·5
Titration in 500 c.c. water	0 1·4	1·4			
1 Cl + ½ NH_3 = equivalents	CCl_4 0·1 0·2	0·3	0·9 0·2	1·1	1·4
	CS_2 0·1 0·1	0·2	1·0 0·1	1·1	1·3
Titration in 500 c.c. water	0·9 0·4	1·3			
Compound made by interaction of Cl_2 and ammonium chloride	CCl_4 0·2 1·6	1·8	0 0·2	0·2	2·0
	CS_2 0 1·6	1·6	0 0·2	0·2	1·8

Remarks.—Note similarity of the behaviour of the last compound and the compound made from an equivalent of Cl_2 and ½ an equivalent of NH_3. On the whole the extraction of this compound is more perfect.

(4) Examination of results obtained by dosing 0·5 grm. Cl_2 into a 11-gallon-tank, water in tank containing 0·25 grm. NH_3.

Titration, 355 c.c. against N/100 thiosulphate $= \frac{1·5 \quad 2·5}{4}$, should be 10 p.p.m.

What is the second fraction?

177 c.c. of water extracted with 88 CCl_4.

CCl_4		Residue
Nil	..	1·3 0·5
		1·8

This second titration fraction is not extracted by CCl_4 in this concentration.

(5) Comparison of titrations, extractions, and germicidal power. An amount of chlorine calculated to give 1 p.p.m. of Cl_2 in the tank was used for initial contact in flasks. Pollution = 25 c.c. of broth culture, 2,000 per c.c. per 11-gallon tank. For titration and extraction 20 c.c. of 25 p.p.m. solution used.

	Compound made from $NH_4Cl + Cl_2$		Cl_2 only		1 Cl_2 + ¼ NH_3		1 Cl_2 + ½ NH_3	
Plating, ½ hour ..	Some hundreds *B. coli* (best)		Mass of growth (worst)		Some hundreds (next best)		Some hundreds	
,, 1 ,, ..	Negative		Hundreds *B. coli*		Negative		Negative	
Titration of 20 c.c. in 500 water ..	0·9 0·6		1·2 0		0·5 0·7		0·9 0·2	
	1·4		1·2		1·3		1·1	
Extractions ..	CCl_4	Water residue	CCl_4	Water residue	CCl_4	Water residue	CCl_4	Water residue
	0·6 0·5	0 0·2	0	0·5 0	0 0·5	0·5 0·2	0 0·1	0·9 0·2
	1·1	0·2			0·5	0·7	0·1	1·1
	1·3		0·5		1·2		1·2	

Remarks.—As these mixtures were not allowed prolonged contact on the bench, the titration differences are not so marked.

This does not seem to have affected their extraction by CCl_4. Again, compound made from NH_4Cl is extracted best, closely followed by the compound made by an equivalent of Cl_2 and ½ equivalent of NH_3.

From the germicidal point of view all are efficient, and there is little to choose between them.

(6) Repeat previous Experiment.

	A	B	C	D
	Compound made from NH_4Cl	1 Cl + ¼ NH_3	1 Cl + ¼ NH_3 by making a mixture of equivalents and then redosing with an equivalent of Cl_2	1 Cl_2 + ½ NH_3
Plating, ½ hour ..	2 cols. *B. coli*	1 col. *B. coli*	Sterile	Sterile
,, 1 ,, ..	Sterile	No coli	No coli	No coli
Titration of tanks after 4 hours ..	0·1 0·4	0 0·7	0 0·7	0·4 0·2
	0·5	0·7	0·7	0·6

Examination of similar solutions :—

	A		B		D	
20 c.c. in 500 c.c. water titrations	0·1 0·7		0·1 1·2		0·9 0·4	
	0·8		1·3		1·3	
Extractions ..	CCl_4	Water residue	CCl_4	Water residue	CCl_4	Water residue
	0 0·6	0 0·4	0 0·6	0·1 0·7	0 0·2	0·8 0·2
	0·6	0·4	0·6	0·8	0·2	1·0
	1		1·4		1·2	

Remarks.—Although no *B. coli* colonies appeared, some of the plates showed a mould contamination frequently present in this water. General results similar to previous ones.

(7) Repeat germicidal comparative tests of compounds made from NH_4Cl and equivalents of NH_3 and Cl_2, and an equivalent of Cl_2 and half an equivalent of NH_3. An estimated 1 p.p.m. Cl_2 dosed into flasks for contact prior to pouring into 11-gallon tanks.

Indicators, 25 c.c. of watery suspension of 2,000 million per c.c. in each tank.

		$1\,Cl_2 + \frac{1}{4}\,NH_3$	$1\,Cl_2 + \frac{1}{2}\,NH_3$	Compound from NH_4Cl.
Platings—				
¼ hour	..	Some thousands	Same as previous plate	Best, about 200
½ ,,	..	About 1,000	About 200	Best, about 150 cols.
Titrations—		0·1 C·75	0·6 0·25	0·1 0·5
½ hour	..	0·85 p.p.m.	0·85 p.p.m.	0·6 p.p.m.

Action delayed by low temperature of water, 4° C. A very excellent result when the enormous dose of organisms is considered; little to choose between these bodies. Equivalents superior to $1\,Cl + \frac{1}{4}\,NH_3$.

(8) Chloramines made by Race's method by interaction of bleach and NH_3 and using his concentrations. Dosed into 2-litre flasks to give concentration of 25 p.p.m. in accordance with previous experiments, using 20 c.c. for extraction with CCl_4.

CCl_4	Water residue
trace, less than 0·1	$\frac{1{\cdot}1 \quad 0{\cdot}1}{1{\cdot}2}$

$$\frac{\text{trace, less than } 0{\cdot}1 \qquad 1{\cdot}2}{1{\cdot}3}$$

Dosed into 11-gallon tank should give 1 p.p.m.

Titration of 355 c.c. against N/100 thiosulphate $= \frac{0{\cdot}7 \quad 0{\cdot}2}{0{\cdot}9}$

Remarks.—Typical titration and extraction given by mixture of equivalents.

Now using half the amount of $NH_3 = 1\,Cl + \frac{1}{4}\,NH_3$, 20 c.c. per extraction.

(1)

CCl_4	Water residue
$\frac{0 \quad 0{\cdot}2}{0{\cdot}2}$	$\frac{0{\cdot}8 \quad 0{\cdot}3}{1{\cdot}1}$

$$\frac{0{\cdot}2 \qquad 1{\cdot}1}{1{\cdot}3}$$

Dosed into 11-gallon tank.
Titration of 355 c.c. with N/100 thiosulphate solution

$$\frac{0{\cdot}7 \quad 0{\cdot}2}{0{\cdot}9}$$

(2)

Repeated, allowing longer contact between bleach and ammonia solution

CCl_4	Water residue
$\frac{0 \quad 0{\cdot}1}{0{\cdot}1}$	$\frac{0{\cdot}4 \quad 0{\cdot}6}{1}$

$$\frac{0{\cdot}1 \qquad 1}{1{\cdot}1}$$

Dosed into 11-gallon tank.
Titration of 355 c.c. with N/100 thiosulphate solution

$$\frac{0{\cdot}3 \quad 0{\cdot}5}{0{\cdot}8}$$

Remarks.—Results with equivalents very similar to those obtained with NH_3 and Cl_2, but results with an equivalent of Cl_2 as bleach and ½ an equivalent of NH_3 not so definite. If longer contact is permitted, there is a definite increase in the second fraction, but solubility of this in CCl_4 is

poor. Is this due to imperfect combination or due to effect of base Ca? In any case, behaviour of mixture of equivalents is similar to compound made by us. The germicidal powers are also similar.

Series O.

When testing these compounds against River Lee water at Middlesex Wharf, in company with Major Elliott, O.B.E., D.Sc., etc., Instructor in Chemistry, Royal Army Medical College, it was found that this water which usually absorbed 2 p.p.m. by the Horrocks test, absorbed 5 p.p.m. as bleach, and more than 6 p.p.m. as chlorine. This was unusual, and the difference between the absorption of hypochlorite and Cl_2 was inexplicable. Samples of this water examined later on two occasions as below :—

Sample 1, showed NH_3, F and S	11·0 p.p.m.
Nitrites	2·0 ,,
Sample 2, taken after rain, October 7, showed NH_3, F and S ..	3·28 ,,
Nitrites	0·16 ,,

Doing comparative Horrocks tests, using (*a*) Cl_2, (*b*) bleach solution, (*c*) combinations of equivalents of NH_3 and Cl_2, (*d*) combination of 2 equivalents of Cl_2 to 1 of NH_3.

Readings—Chlorine gas	3rd cup
Bleach	2nd ,,
Equivalents of NH_3 and Cl_2	1st ,,
2 of Cl_2 to 1 of NH_3	1st ,,

Remarks.—Previous subsidiary tests had shown that although Cl_2 behaved regularly in regard to absorption in presence of nitrites, hypochlorite (bleach) did not. This is apparent from the above. The resistance of chlorine ammonia compounds to absorption is of interest. It appeared that further investigation was desirable.

(2) The effects of increasing amounts of NH_3 in water upon germicidal velocity, titration results, bleaching powers, etc., in 11-gallon tanks, all dosed with 0·05 grm. of Cl_2 = 1 p.p.m. NH_3 mixed in water first. Comparative weights shown.

Indicators, 1 c.c. of watery suspension *B. coli* = 2,000 million per c.c. per tank.

	Cl_2 alone	Cl_2 + ½ NH_3	Cl_2 + 1 NH_3	Cl_2 + 2 NH_3	Cl_2 + 4 NH_3
Platings—					
5 minutes ..	Large growth	2 cols.	Large growth	Mass of growth	Mass of growth
10 ,, ..	Some reduction	1 col.	,,	,,	,,
20 ,, ..	,,	1 ,,	,,	,,	,,
Titrations ..	0·3 0·1 / 0·4	0·8 0·1 / 0·9	0·7 0·2 / 0·9	0·5 0·3 / 0·8	0·4 0·5 / 0·9
After 24 hours..	0	0·5 0·05 / 0·55	0·6 0·05 / 0·65	0·6 0·15 / 0·75	0·3 0·5 / 0·8

It was demonstrated that although 250 c.c. water from Cl_2 tank, containing only 0·4 p.p.m. available Cl_2, possessed considerable bleaching properties against dilute dye, in all tanks containing NH_3 bleaching had practically ceased. After prolonged contact the chlorinated ammonized water bleached 0·3 c.c. of dye in the presence of acid.

Attempts at extraction of the compound in the tank showing the large second fraction, showed that the second fraction compound could not be extracted. This second fraction is seen to increase with the amount of NH_3 present and is attributed to action of excess base. The conservative action of NH_3 upon available chlorine is well shown, also the retardation of germicidal velocity by excess of ammonia. The results obtained originally in the flasks receive confirmation.

(3) Effect of adding chlorine and various compounds having an estimated concentration of 1 p.p.m. to tank containing excess of ammonia.

Contained in water: 1 .p.m. H

Cl_2 added. Titration .. .. = $\frac{0\cdot4 \quad 0\cdot2}{0\cdot6}$

Ammonium hypochlorite made by double decomposition = $\frac{0\cdot6 \quad 0\cdot2}{0\cdot8}$

Bleach solution .. .. = $\frac{0\cdot4 \quad 0\cdot1}{0\cdot5}$

4 p.p.m. NH_3 in tanks

Bleach solution .. .. = $\frac{0\cdot2 \quad 0\cdot6}{0\cdot8}$

Remarks.—Again there is a change in the bleach titration caused by increasing the NH_3. N.B.—Also *vide* experiments quoted in text of paper.

(4) The effect of excess ammonia on titration. Compounds made by mixing equivalents of NH_3 and Cl_2 in usual manner and dosed into water containing 10 p.p.m. NH_3.

Titration, 355 c.c. N/100 thiosulphate solution.

$\frac{1}{2}$ hour, $\frac{0\cdot2 \quad 0\cdot5}{0\cdot7}$; 1 hour, $\frac{0\cdot35 \quad 0\cdot35}{0\cdot7}$; 24 hours, $\frac{0 \quad 0\cdot7}{0\cdot7}$

Same concentration of NH_3 in water, using pouring technique as performed in regimental water-cart.

$\frac{1}{2}$ hour, $\frac{0\cdot3 \quad 0\cdot45}{0\cdot75}$; hour, $\frac{0\cdot3 \quad 0\cdot45}{0\cdot75}$; 24 hours, $\frac{0 \quad 0\cdot6}{0\cdot6}$

Attempts at extraction of this body with solvents showed it present in watery residue only. Hence it appears that excess of ammonia may modify these titration results although solubility may also be affected by differences in concentration.

Previous experiments demonstrated that titration results of both Cl_2 solution and chlorine ammonia compounds can be modified by presence of excess NH_3 in water. The following demonstrates the effect upon germicidal power. Broth culture 25 c.c. per 11-gallon tank.

	$1\ Cl_2 + \frac{1}{2}\ NH_3$ (given initial contact in 2-litre flask)		Cl_2 only.	
Water containing :	2 p.p.m. NH_3	4 p.p.m.	2 p.p.m.	4 p.p.m.
Plating, ½ hour	About 100	Some hundreds	Film of growth	Film of growth
,, 1 ,,	Negative	Negative	About 100	53 cols.
,, 1½ ,,	,,	,,	Negative	Negative
Titration, ½ hour	0·4 0·2 / 0·6	0·4 0·25 / 0·65	0·5 0·2 / 0·7	0·45 0·3 / 0·75
,, 1½ ,,	0·4 0·25 / 0·65	0·5 0·15 / 0·65	0·5 0·2 / 0·7	0·45 0·2 / 0·65

Remarks.—Excess NH_3 has resulted in the production of second titration fraction with chlorine. This combination is not as effective as the compounds formed by the interaction of equivalents in ideal concentration.

Horrocks Test Results.

Above ordinary water, with Cl_2	.. ..	= 2nd cup
,, ,, ,, ,, bleach	..	= 2nd cup
,, tanks, containing 2 NH_3 and broth		
Cl_2	.. ..	= nearly 1st cup (2nd cup)
Bleach	..	= 1st cup
,, containing 4 NH_3 and broth		
Bleach	..	= 1st cup
Cl_2	.. ..	= 1st cup, but a little absorption not as deep as bleach

Remarks.—It appears that bleach and Cl_2 do not react equally in presence of NH_3, bleach being more readily affected.

Series P.

Having obtained certain information regarding the behaviour of chlorine and some of its compounds in the presence of NH_3, it appeared desirable to investigate the effect of the presence of both NH_3 and NO_2.

At first it was impossible to obtain waters containing suitable quantities of NH_3 and NO_2. It appeared that standard silver nitrate, although behaving in a regular manner with Cl_2, reacted in an irregular manner, and sometimes not at all, with bleach.

As ammonium nitrite should be commonly present in waters containing ammonia and NO_2, this compound was prepared by the interaction of $Ba(NO_2)_2$ and $(NH_4)_2SO_4$ and proved satisfactory. In regard to indicators, it was realized that trouble would arise in the presence of NO_2. An attempt to get over this difficulty was made by employing O-tolidin, which is stated to be superior to starch and KI in the presence of nitrites. It was found to be an excellent indicator from the point of view of making a rapid estimation of Cl_2 against standards, but it was also affected by the large amount of NO_2 used and offered little advantage. It is true in certain instances when both Cl_2 and NO_2 had been used up by interaction O-tolidin gave lighter tints, but our usual indicator, starch and KI did likewise.

(1) Horrocks test	Plain water and nitrite 1 p.p.m.	Nitrite 1 p.p.m. and 2 p.p.m. NH_3	Nitrite 1 p.p.m. and 4 p.p.m. NH_3
Cl_2	3rd cup	2nd cup	2nd cup
Bleach	1st cup	1st cup	1st cup
Chlorine ammonia compounds made by contact of equivalents of NH_3 and Cl_2	1st cup	1st cup	1st cup

Remarks.—An attempt at titration with acid was made, but a mixed chlorine second fraction and nitrite fraction appeared, and no reading could be obtained. It shows that the Cl_2 reading is modified in the presence of excess ammonia. Chlorine ammonia compounds are unaffected.

(2) Repeat with Bourley water with 0·125 NO_2 per million—it being found that the above standard nitrite was not dependable.

	0·125 NO_2 in water	0·125 NO_2 and 2 p.p.m. NH_3	0·125 NO_2 and 4 p.p.m. NH_3
Cl_2	2nd cup	1st cup (little absorption)	1st cup
Bleach	2nd cup	1st cup	1st cup
Chlorine ammonia compounds made by initial contact of equivalents of Cl_2 and NH_3	1st cup	1st cup	1st cup

Remarks.—Chlorine ammonia compounds still unaffected. The action of NH_3 on Cl_2 and hypochlorite is represented.

(3) Horrocks Test—plain water with Cl_2 only = second cup.

Water containing :	2 p.p.m. NO_2	2 NO_2 and 2 p.p.m. NH_3	2 p.p.m. NO_2 and 4 p.p.m. NH_3
Cl_2	5th cup	2nd cup	1st cup
Bleach	2nd cup	1st cup	1st cup
(Cl_2 and $\frac{1}{2}$ NH_3 compound)[1]	1st cup	1st cup	1st cup
(Cl_2 and $\frac{1}{4}$ NH_3 compound)[1]	1st cup (comes up very, very slowly)	1st cup	1st cup

[1] These compounds formed by initial contact in flasks.

Remarks.—Chlorine ammonia compounds, when properly formed in this way, are unaffected. The blocking of oxidation by NH_3 is demonstrated, and the unequal reaction of Cl_2 and bleach.

(4) It is shown above that the blue colour with KI and starch when using an equivalent of Cl_2 and $\frac{1}{2}$ equivalent of NH_3 only develops after prolonged standing. May this not be nitrite?

Acid usually assists the development of a good nitrite reaction with starch and KI. An attempt was made to titrate out NO_2 from Cl_2.

Into all tanks solution of Cl_2 to give 1 p.p.m. was dosed. In the case of chlorine ammonia compounds, mixtures of equivalents of Cl_2 and NH_3 and $\frac{1}{2}$ an equivalent of NH_3 and 1 of Cl_2 were given initial contact in flasks. The dose of available Cl_2 in these should lie between 0·6 and 1 p.p.m.

Tanks containing :

	A	B	C	D	E
	Nitrite only 2 p.p.m.	NO_2 2 p.p.m. NH_3 2 p.p.m.	NO_2 2 p.p.m. NH_3 4 p.p.m.	NO_2 2 p.p.m. NH_3 2 p.p.m.	NO_2 2 p.p.m. NH_3 4 p.p.m.
Added to above :	1 Cl_2 $\frac{1}{2}$ NH_3 compound	Cl_2 1 p.p.m.	Cl_2 1 p.p.m.	1 Cl_2 $\frac{1}{2}$ NH_3 compound	1 Cl_2 $\frac{1}{2}$ NH_3 compound
Titrating 355 c.c. against N/100 thiosulphate :	0 + mixture of 2nd fraction and nitrites	0·5 + mixture of 2nd fraction and nitrites	0·7 + mixture of 2nd fraction and nitrites	0·5 + mixture of 2nd fraction and nitrites	0·5 + mixture of 2nd fraction and nitrites

Remarks.—This titration was carried out expeditiously, so that without prolonged standing no colour appeared in A on the addition of starch and KI. The only way by which it can be proved that the compound in A is not markedly affected by NO_2 is by an examination of the germicidal powers. Chlorine and the compound formed by interaction of equivalents of NH_3 and Cl_2 show the presence of an excellent first fraction of available Cl_2. It is not possible to distinguish a second titration fraction from nitrite.

(5) To verify the previous deductions the following experiments were performed.

Water in tanks containing 25 c.c. broth culture 1,000 million *B. coli* per c.c., a huge load of pollution, all contain 0·125 p.p.m. of NO_2 and varying quantities of NH_3. Into these chlorine and ammonia compounds were dosed.

Tanks containing:	0·125 NO_2 p.p.m. and 2 p.p.m. NH_3.		0·125 NO_2 and 4 p.p.m. NH_3.	
	A	B	C	D
	Cl_2 1 p.p.m.	1 Cl $\frac{1}{2}$ NH_3 compound	Cl_2 1 p.p.m.	1 Cl $\frac{1}{2}$ NH_3 compound
$\frac{1}{2}$ hour plating	an enormous heavy film	Film light	Very heavy film	Very heavy film
1 ,, ,,	Light film	Cols. 110	Light film (better than A)	Cols. some hundreds
Titration	0·4 0·2 / 0·6	0·4 0·3 / 0·7	0·3 0·5 / 0·7	0·2 0·5 / 0·7

Remarks.—Again the superiority of these compounds is shown in the presence of excess ammonia. The amount of NO_2 present being small a second titration fraction can be obtained, the blocking action by the relatively large amount of NH_3 present being effective. To get better information, further tests must be carried out, using larger amounts of NO_2. Note the increased second fraction titration in the presence of the larger quantities of NH_3.

(6) Amount of chlorine used to make compounds in each case represents a theoretical 1 p.p.m. in tanks. Indicators, 2000 million *B. colio* in watery suspension. Comparative results obtained in 11-gallon tanks containing varying quantities of NH_3 and NO_2.

A = NO_2 2 p.p.m. in water into which was dosed	a compound made by interaction of 1 equivalent of Cl_2 and ½ equivalent of NH_3 = (1 Cl_2 + ½ NH_3 by weight)
B = NO_2 2 p.p.m. ,, ,, ,,	equivalents of Cl_2 and NH_3 (1 + ½).
C = NO_2 2 p.p.m. ,, ,, ,,	equivalents of Cl_2 and NH_3 made (1 + ½) from ammon. carb.
D = NO_2 2 p.p.m. ,, ,, ,,	equivalents of Cl_2 and NH_3 made by (1 + ½) by pouring methods.
E = NO_2, NH_3 each 2 p.p.m. ,, ,,	equivalents of Cl_2 and NH_3 made in (1 + ½) usual way.
F = NO_2 2 p.p.m. NH_3 4 p.p.m. ,, ,,	equivalents of Cl_2 and NH_3 made in (1 + ½) usual way.

Plating—	A	B	C	D	E	F
20 minutes ..	3 cols.	6 cols.	No cols.	27 cols.	52 cols.	Over 100 cols.
40 ,, ..	Negative	Negative	Negative	1 col.	10 ,,	61 cols.
1 hour ..	,,	,,	,,	Negative	1 col.	33 ,,
Titrations ..	0·2+NO_2 and 2nd fract.	0·5+NO_2 and 2nd fract.	0·4+NO_2 and 2nd fract.	0·2+NO_2 and 2nd fract.	0·4+NO_2 and 2nd fract.	0·3+NO_2 and 2nd fract.

Remarks.—These compounds do withstand the action of NO_2. It is impossible to titrate out the second chlorine fraction on account of the nitrite reaction. The restraining action of NH_3 on germicidal velocity appears.

Series Q.

(1) The manufacture of a compound behaving in regard to its titration in water, its solubility in CCl_4 and CS_4 and germicidal activity, like the compound made from two equivalents of Cl and one of ammonia.

Varying quantities of NH_4Cl placed in strong chlorine solution in stoppered bottles, using quantities of Cl_2 = 0·5 grm. and NH_4Cl solution = 15 per cent. Hence 10 c.c. of NH_4Cl solution contains 1·5 grm. of NH_4Cl, and of this NH_4 radicle = roughly 0·5 grm. and Cl_2 = 1 grm.

Strength of Cl_2 solution = 0·7 per cent.
Bottles containing 0·5 grm. Cl_2 in 71 c.c.

	A	B	C	D
NH_4Cl 15 per cent	2·5 c.c. = 0·125 grm. NH_3 radicle	5 c.c. = 0·25 grm. NH_3 radicle	10 c.c. = 0·5 grm. NH_3 radicle	20 c.c. = 1 grm. NH_3 radicle

Leave half an hour and solution becomes white. Pungent acrid smell and on shaking very fine bubbles of gas. (Take care of eyes as bubbles break off from the surface and are very irritating.)

KI dissolved in 200 c.c. water, 0·40 c.c. from each bottle is then added in turn.

	A	B	C	D
Titration with N/10 thiosulphate	0·5	0·5	0·4	0·4
0·4 c.c. into 500 c.c. of tap-water	0·1 0·55 / 0·65	0 0·6 / 0·6	0 0·6 / 0 6	0 0·5 / 0·5
After 1 hour, 5 c.c. dosed into KI, and titrated against N/10 thiosulphate	5·3	5	5 gassing N_2	4·9 gassing freely N_2
After 12 hours =	1·7	1·9		

Poor bleaching properties. Also *vide* first fraction in water.

Best results, with 5 c.c., and 10 c.c. NH_4Cl.

Amount produced = 50 per cent of available Cl_2 or 3,600 p.p.m. Larger ratios of NH_4Cl lead to loss by excessive formation of HCl and evolution of N .

(2) Repeat exactly the same, using 0·5 grm. Cl_2. Strength Cl_2 151 c.c. = 0·5 grm.

	A	B	C	D
NH_4Cl 15 per cent	2·5 c.c.	5 c.c.	10 c.c.	20 c.c.
After ¼ hour, 1 c.c. added to KI solution.				
Titration, N/10 thiosulphate	0·5 c.c.	0·25 0·2 0·45	0·25 0·15 0·4	0·15 0·35 0·5
After ½ hour, 0·1 c.c. in 500 c.c. of tap-water.				
,, N/100 thiosulphate		0·05 0·30 0·35	0·1 0·3 0·4	0·25 0·2 0·45
After ¾ hour, 1 c.c. to KI solution.				
,, N/10 thiosulphate		0·20 0·25 0·45	0·2 0·2 0·4	0·2 0·25 0·45 (gassing freely) N_2
,, 0·1 c.c. to 500 c.c. H_2O. N/100 thiosulphate		0 0·3 0·3	0 0·4 0·4	0 0·3 0·3
,, 1 hour, 10 c.c. into KI solution and acid		4·4	4·3	3·8
,, 12 hours, N/10 thiosulphate .. =		2 c.c.	1·5 c.c.	1 c.c.

Poor bleaching powers. Note that the complete second fraction does not become apparent until the compound is in extremely dilute solution. Note loss after twelve hours' exposure.

(3) Ranging downwards, as above. 10·5 grm. Cl_2 used.

	A	B	C	D	E
	Cl only	NH_4Cl 15 % 0·25 c.c.	0·5 c.c.	0·75 c.c.	1 c.c.
After ½ hour add to 2-litre flasks = approx. 250 p.p.m. of Cl.					
Titration: 20 c.c. in 500 c.c. H_2O N/100 thiosulphate	9·9 0	6·5 1 7·1	5·5 1·5 7	7 1 8	7 0·6 7·6

Extraction: of 20 c.c. with CCl_4	CCl_4	Water residue	CCl_4	Water residue	CCl_4	Water residue	CCl_4	Water residue	CCl_4	Water residue
	3 0 3·0	4·1 0 4·1	3 0·3 3·3	1 0 1	4 0·5 4·5	0·1 0 0·1	4·4 1·7 6·1	0·1 0 0·1	4 1·8 5·8	0
	7·1		4·3		5·6		6·2		5·8	

Remarks.—This is an extremely interesting experiment to interpret It has been observed that Cl_2 is extracted by CCl_4 from strong aqueou solution. In concentrations of 25 parts per million it behaves like HClO and is not extracted. Here in a concentration of 250 parts per million it is partially extracted, at the same time a considerable loss occurs. Even with the lowest concentration of NH_4Cl = 0·25 c.c. = 0·0375 of ammonium chloride = 0·0125 of NH_3 radicle, a second titration figure begins to appear and concurrently a fall in the available Cl_2 figure is

observed. With increasing amounts of NH_4Cl the fraction of available Cl_2 left in the watery residue becomes steadily smaller, until with 1 c.c. of NH_4Cl the whole of the available chlorine is abstracted from aqueous solution.

The above solutions vary in colour, from the yellow of the chlorine control to dead white when using 1 c.c. of NH_4Cl. The solution B has certain bleaching properties, and with increasing quantities of NH_4Cl in C, D and E, this power diminishes. From the titration figures the largest second fractions appear with 1 c.c. of $NH_4Cl = 0{\cdot}15$ grm., viz., 1·8, and is completely extracted by CCl_4.

During these experiments, and the experiments using diffusers, two types of gas bubbles were observed—extremely fine ones, which become more apparent on shaking, and coarse ones. The former are chloramines and the latter nitrogen, a sure index of excess ammonia. The evolution of N_2 is accompanied by excessive loss of available Cl_2. It should be realized that the rapidity of this reaction is largely dependent upon the dilution of the reagents and the temperature, and when this approximates to freezing point the reaction may remain imperfect or take hours to complete. If other ammonium salts, NH_4NO_3, $(NH_4)_2SO_4$, are used in appropriate quantities, having due regard to the relative NH_4 content, similar results can be obtained. The germicidal powers, etc., of this compound have already been described.

Series R.—The Ammonium Carbonate Tablet.

Ammonium carbonate on exposure to air gives off ammonia and becomes ammonium hydrogen carbonate.

$$(NH_4)_2CO_3 = H(NH_4)CO_3 + NH_3$$
$$(NH_4)\ CO_3 = 36 + 60 = 96 = 37 \text{ per cent } NH_4$$

therefore 0·25 grm. of $NH_3 = 0{\cdot}66$ grm. of $(NH_4)CO_3$ = an equivalent of 0·5 grm. of Cl_2.

Old $(NH_4)_2CO_3$ may have an available NH_3 content of 18 per cent, equals 50 per cent loss. If the amount of ammonia entering into combination with 0·5 grm. of Cl_2 is 0·125 grm. instead of 0·25 grm., the second fraction chloramine is formed. When amounts of NH_3 short of 0·5 grm. are used (a double equivalent) the first fraction chloramine is produced. Hence when using NH_3 we have a margin of safety on each side of the optimum, 0·25 grm., up to 0·5 grm. and down to 0·125 grm.

If ammonium carbonate is exposed for some time two types of deterioration may be anticipated: (1) An actual loss of weight by volatilization, (2) loss of NH_3 content by gradual conversion into hydrogen ammonium carbonate.

Provided the tablets are packed in small quantities the first type of deterioration is of little importance, but the second requires particular attention. To safeguard ourselves against these contingencies, a tablet of

ammon. carb. weighing 1 grm. is suggested. Should this not prove satisfactory it may be necessary to specify hydrogen ammonium carbonate instead of normal carbonate.

If the ammonium carbonate is up to full strength it is within the upward range of safety of two equivalents (1·32 grm.). If it is old it will still contain 0·135 grm. of NH_4 which is within the lower margin for the production of the second fraction chloramine. Under average conditions the tablet should contain NH_3 slightly in excess of 0·25 grm., which is the estimated optimum.

Series S.

The formation of chloramines by the interaction of simple solutions without appreciable loss of available Cl_2 is not in conformation with the following equation :—

$$NH_4OH + Cl_2 = NH_2Cl + HCl + H_2O$$

To account for these results certain theories which appear to have a reasonable basis have been advanced in the Section "Significance of Foregoing Remarks."

Evidence has been adduced, particularly in New Series F, Experiment 5; Series J, Experiments 2 and 4; Series L, Experiment 1; Series M, Experiments 2, 3, 4; Series N, that two compounds are formed endowed with considerable germicidal powers: (1) by a combination of equivalents of Cl_2 and NH_3; (2) by interaction of two equivalents of Cl_2 with one of NH_3 and that the former can be changed to the latter by the addition of an equivalent of Cl_2. If further additions of Cl_2 are made compounds containing higher ratios of Cl_2 are not formed under these conditions, and the Cl_2 remains as free Cl_2.

In support of the foregoing, the possibility arises that further proof may be afforded by conductivity tests, in which a marked rise in the conductivity figure would be indicative of HCl formation.

The water used for these tests had an initial conductivity of 5 reciprocal megohms, and although not ideal was of sufficiently good quality to ensure reasonable results.

Cl_2 in grm. per 2 litres	NH_3 in grm. per 2 litres	Conductivity in reciprocal megohms
—	—	5
—	0·025	35
0·05	—	100
0·05	0·025	70
—	0·0125	27
0·05	0·0125	50 (repeat) 46
Hydrochloric acid 0·05	—	260
Ammon. chloride 0·075	—	95

Remarks.—Note the marked differences between the conductivity of solutions of Cl_2 and $Cl_2 + NH_3$ combinations. There is no marked rise due to formation of ionized HCl.

	Cl_2 in grm. per 2 litres		NH_3 in grm. per 2 litres		Conductivity in reciprocal megohms
	—	..	—	..	5
	—	..	0·05	..	47
	0·1	..	—	..	255
	0·1	..	0·05	..	130
	0·2	..	—	..	490
	0·2	..	0·05	..	295
	0·3	..	0·05	..	540
HCl[1]	0·1	..	—	..	515
Ammon. chloride	0·15	..	—	..	195

[1] Note that the addition of an equivalent of Cl_2 to a solution containing two equivalents of Cl_2 and one of NH_3 leads to a marked rise in the conductivity. If this were due to free Cl_2 the increase should be something below 255 megohms, and it is 245 megohms. There is no evidence pointing to HCl formation.

Remarks.—Regarding the reactions which take place between ammonium chloride and chlorine solutions, Experiment 3, Series Q, indicates that when the chlorine and ammonium chloride solutions are correctly adjusted one stage may be represented thus :—

$$NH_4Cl + 2\ Cl_2 = NHCl_2 + 3\ HCl.$$

In the hands of Dr. E. B. Higgins quantitative estimations of HCl formation are confirmatory.

In the performance of the conductivity tests I am indebted to Messrs. United Water Softeners, Ltd., for the use of apparatus and their Research Laboratories at Brentford, and for the collaboration of their technical staff under the direction of Dr. E. B. Higgins.

Series T.

Numerous confirmatory experiments, and especially those connected with the bleaching, have been omitted.

The production of chloramines by means of diffusers has not been described, as most of the points regarding this method are covered by the foregoing experiments.

The methods described in this paper are covered by Provisional Patents (with War Office approval), and are being independently investigated by water experts. I wish to acknowledge the facilities afforded me by Colonel A. H. Safford, Officer Commanding the Army School of Hygiene, the assistance of Captain McKibbin and Serjeant Mace, R.A.M.C., who were responsible for the majority of standard solutions used, and Private Bowness, upon whom fell the brunt of work connected with media making and sterilization.

FLY CONTROL BY MEANS OF THE FLY-LARVAL-TRAP MANURE ENCLOSURE.

By Captain E. BABER,
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A Simple and Inexpensive Device for Storing Manure and Fermenting Waste Matters in such a manner as to trap all Fly Larvæ migrating therefrom.

The fly-larval-trap described here has been given very extensive trial under varying circumstances, not only at military centres, but by civil authorities and others, and has proved of value in all cases where manure or other fermenting animal or vegetable waste matters are accumulated in such a way as to give rise to fly-breeding; it is cheap to construct and requires little attention.

An improvised form of the fly-larval trap, employing the same principle, was first introduced during the war at the Potchefstroom mobilization camp for dealing with the manure of about 1,000 horses. This improvised device was described in the *Lancet* of March 13, 1918.

In the control of the breeding of flies proper storage of manure is a fundamental factor, and it is believed that the simple arrangement which the writer has devised for this purpose, and which is described herein, will be widely adopted as it becomes more generally known.

To those unacquainted with the usual life cycle of the common fly a few remarks in this connexion will possibly help to a better understanding of the working of the larval trap.

Flies find a favourite breeding place in the manure of horses, cattle and other animals, also in fermenting filth generally, provided it is fairly moist and furnishes the necessary heat for the hatching of the eggs and food for the larvæ. They develop through successive stages so dissimilar as to suggest wholly different forms of life. The female lays 120 to 150 eggs at a time, and may lay several times during the season, so that each female may produce 600 to 900 eggs. The eggs are usually deposited in batches on the surface of the breeding place, and hatch out in from eight hours to three days to a small larva, cream-coloured, and about three-eighths of an inch in length.

The larvæ feed on the decomposing material in which they have been batched, and in warm weather become fully grown in about five days. They then migrate from the hatching ground (usually at night) and burrow into the subjacent ground to a depth of a few inches, where the body shrinks to an elongated barrel shape; the outer skin hardens slowly and later takes on a deep brown colour, forming the pupa or chrysalis.

The pupal stage lasts three to four days under favourable conditions and the fly emerges, then working its way through the soil to the surface. At first the wings are crumpled and folded, and until these expand the flies are often seen running over the breeding ground looking somewhat like spiders. About an hour after emergence the wings are fully expanded, and a little later the fly is capable of flight.

The total life round may be as short as seven days under favourable conditions, though during cold weather this may be extended almost indefinitely; sexual maturity is reached at the end of a further ten days when the female lays her eggs, and so the cycle goes on.

To contend with the fly it is necessary to abolish all possible breeding places, and in this connection it is important to remember that in ninety per cent of cases stable manure is chosen by the female fly when depositing her eggs. As a result of many observations made by the writer it has been found that an average of 5,000 fly larvæ mature and migrate from the amount of manure which would fill an ordinary 200 lb. grain bag, or 130,000 from a single Scotch cart-load of manure. These figures represent average catches obtained during summer months in a place where adult flies were not particularly numerous.

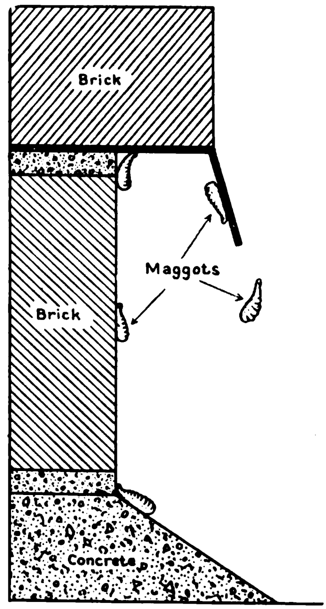
The larvæ are not very easily suppressed, and although buried beneath two feet of soil will complete their life cycle and later appear on the surface as flies. It is also interesting to note that the larvæ may be kept submerged in water for twenty-four hours and yet become very active when taken from the water and placed in the sun.

The larvæ are unable to climb a perpendicular dry surface, though if such surface be wet or damp, or if only the body of the larvæ be moist, they have considerable ability to climb; they can even climb out of an ordinary glass tumbler with the aid of moisture. As a result of many experiments carried out by the writer it has been found that fly larvæ cannot climb around an overhanging sharp edge, even with the aid of moisture; this fact has been taken advantage of in designing the larval-trap, the metal overhang of which forms an essential part of the device.

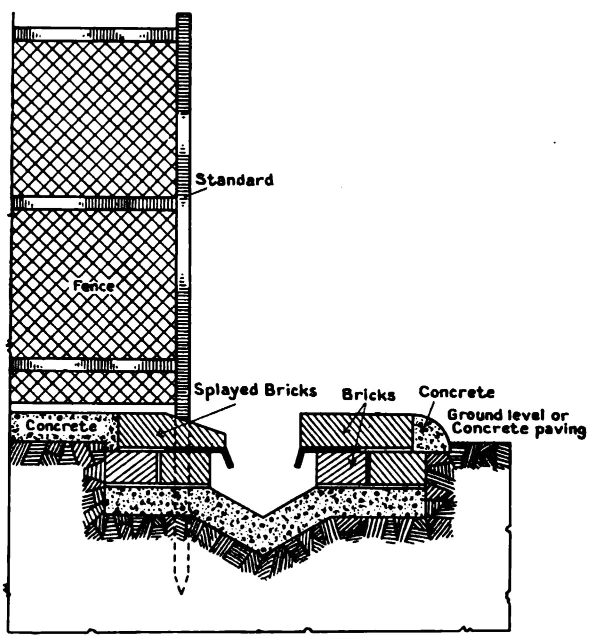
Influence of Temperature and Moisture.

During all stages of its life-round the fly is greatly influenced by temperature and moisture, this is particularly the case during the larval or maggot stage, when it moves from one part of a manure heap to another in great colonies seeking the optimum temperature and moisture for feeding, and later, in which to pass to the next stage of its development, i.e., the pupal or chrysalis stage. Colonies of pupæ numbering thousands may often be found among the outer layers of a loosely packed manure heap.

The larvæ prefer a temperature of about 90° F. and quickly succumb to a temperature of 115° F. or above, particularly if the manure or other fermenting material is in a wet state, when a temperature of 105° F. is fatal.



Maggot falling back into the Trench.



Trench and Fence Complete.

When fresh manure, with or without the addition of bedding, is placed in a heap, it rapidly heats consequent on the fermentation of organic matter, the heating is much more rapid when the manure is damp and is compressed or stacked firmly. The writer has observed a firmly-stacked heap of fresh manure to heat up to 140° F. and the larvæ come tumbling out within thirty minutes of stacking, on the following day the heap registered 160° F., on the fourteenth day it registered 130° F. and thereafter the temperature gradually declined.

The temperature varies according to the degree of density of the manure heap, the amount of moisture it contains, the freshness of the manure, also on the percentage of bedding present; it is naturally lower in the outer layers, where it is just above that of the surrounding atmosphere. At an inch or two below the surface it increases and at a depth of six to twelve inches, depending upon compactness, frequently reaches 130° to 150° F. in the case of fresh manure.

A continuous record was recently made in Pretoria of the varying temperature of manure heaps, and it was found that a manure heap measuring 4 feet by 4 feet by 4 feet reached and maintained a temperature of 120° to 130° F. for seven weeks, when it gradually cooled, but registered 80° F. at the end of fourteen weeks, this heap was regularly wetted with four gallons of water daily. A similar heap maintained under identical conditions, but in a perfectly dry state, consistently registered 20° lower throughout the whole period. These observations were made during the cool months when light night-frosts were experienced.

The Larval-trap.

Having briefly detailed the usual life-cycle of the fly, the manner of constructing the larval-trap will now be dealt with.

Detailed illustrations are given of the device which should render the construction a comparatively simple matter. The whole structure should be substantially built so as to enable it to withstand very hard and rough usage, and exposure to weather. The platform is best built in good concrete, but may if preferred be of brick grouted in cement.

The construction of the trench or channel requires some care, building it of brick is probably the simplest way and this method is shown in the diagram; it may of course be built of concrete, though this will entail the making of suitable moulds.

The Overhang.

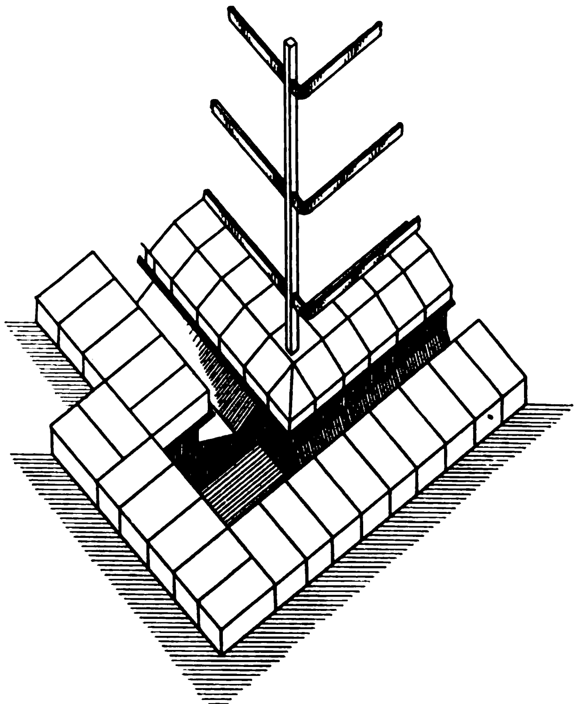
The metal overhang is the essential part of the device, as it prevents the escape of the larvæ from the trench and sump and should under no circumstances be omitted. It may be conveniently made from ordinary sheet galvanized iron, cut into strips 6 inches wide and bent down 1½ inches as shown in the drawing, it is then laid in position between the courses of bricks and projects out over the trench. The top course of bricks is brought out to protect the metal from damage.

All joints in the metal overhang must slightly overlap, as, should any openings be left between the ends of the metal strips, the larvæ will certainly find them and escape.

The edge of the inner side of the trench should be bevelled as shown, so that the larvæ falling thereon may not be able to crawl back into the manure but will roll down the inclined surface direct into the trench.

The Sump.

A sump of suitable size is necessary for the collection of liquids flowing from the manure. The sump must be provided with the metal overhang



Isometric View showing Sump of Corner.

in precisely the same way as previously described for the channel; this is specially important, as the larvæ invariably find their way along the channels to the sump and the majority will usually be found there.

The liquids are best thrown back on to the manure heap, where they assist fermentation.

In very dry climates much better results will be obtained if the manure heap is regularly wetted, and where large installations are concerned it is desirable to arrange for the special provision of water for the purpose; it is also a useful measure to fix a small hand-pump for returning the liquids contained in the sump back again to the manure heap. As already

mentioned, moisture assists fermentation and the generation of heat, also as damp heat is much more repugnant to the larvæ than dry, they migrate from a moist manure heap more rapidly and completely than from a dry heap.

The bottom of the sump should be concave, this facilitates the removal of liquids and larvæ.

Removal of Manure from the Larval-trap.

An important point with regard to the use of the larval-trap is to decide when it is safe, from the standpoint of safety from further fly-breeding, to remove the manure from the trap. This point does not arise in cases where the larval-trap is used at stables for the temporary storage of manure pending regular removal, such as occurs with town stables from which the manure is removed at fairly close intervals, but is of much importance where larval-traps are used on a large scale for the final storage of manure pending its use for agricultural purposes, as by Government Institutions and Municipalities.

Decision in regard to this point is largely dependent on temperature and climatic conditions, also on the exact composition of the manure heap. In South Africa, under normal summer conditions, the writer has found that the maximum migration of the larvæ is from the fifth to the twelfth day, after which it rapidly decreases, until by the twenty-first day it almost ceases. It should be noted that these periods are given as commonly occurring under our average summer conditions, the periods may be greatly extended under unfavourable conditions of temperature, moisture, etc. Generally speaking, therefore, it is safe to remove the manure from the platform after it is four weeks old, for fertilizer purposes, or for storage elsewhere, without appreciable danger from fly-breeding; but this must not be considered a definite rule, as even after this period the heap may again heat up if wetted by warm rains, under such circumstances it may again, to a small extent, become attractive to the egg-laying fly. It is found that such conditions are unusual and the number of larvæ which mature and migrate during the second period is but a fraction of the number during the first period of fermentation.

Size and Number of Larval-Traps Required.

The next point for consideration is the matter of the size and number of larval-traps which should be constructed under given circumstances.

In the case of ordinary stables, where but one larval-trap is installed and manure is stored temporarily pending regular removal, there is very little difficulty in deciding upon the dimensions; provision being necessary only for the maximum quantity of manure likely to accumulate between the intervals of removal.

Where large quantities of manure and fermenting waste matters are stored for the purpose of rotting down for agricultural purposes, the

question of the number and dimensions of the larval-traps becomes very important. Under such circumstances the provision of a series of four or five larval-traps is recommended, each capable of holding about a week or ten days' accumulation, the principle being, that whilst one of the enclosures is being filled the contents of the others will be rotting down and the larvæ migrating therefrom; these full enclosures will then be ready for clearing in rotation as required. Where a series of larval-traps is arranged it is a useful measure to connect all channels to one large sump, and to fix a pump for returning the liquids to the manure to assist in the fermentation process and to increase the fertilizing properties of the manure.

Hints on Management of Larval-Trap.

Like all sanitary devices the larval-trap requires at least some slight attention if it is to give satisfaction, and such attention will be well repaid.

In filling the enclosure the manure should be firmly stocked, particular attention being given to tightly pack the material against the wire surrounding the enclosure.

Larvæ should be removed from the trenches and sump two or three times a week and suitably disposed of; they may be fed to poultry, subject to care being taken to prevent them escaping; they may be destroyed with boiling water or a solution of any of the commonly used disinfectants.

The trench must be kept clean and free from any litter or other material falling from waggons or enclosures, as litter in the trench may easily afford means for larvæ to escape.

Most of the larvæ will usually be found in the sump into which they fall in the course of their journey along the trench. The writer prefers to maintain the trenches free from liquid, though some users keep a quantity of solution in the sump with the object of drowning the larvæ; this latter method is unnecessary, though if a 1 in 100 solution of arsenite of soda is used for this purpose it acts at the same time as a poison-bait for flies in the adult stage.

The Larval-Trap and Abattoir Waste.

The temporary storage or disposal of the waste from abattoirs in such a way as to prevent the breeding of flies is commonly a matter of very considerable difficulty, and whilst it is not claimed that the larval-trap will entirely eliminate this difficulty, it is the case that more than one municipality have installed them for this purpose and are getting good results therefrom. In this connection I cannot do better than quote Mr. Walton Jameson, City Engineer of Kimberley, who writes:—

"You will be interested to note that when I was in Mafeking some time ago I visited the local abattoir and found the building teeming with flies, both blue-bottle and the ordinary house-fly. I suggested to

the municipal authorities that they should put up a fly-trap, and sent them a copy of Captain Baber's design, similar to the one we are using here. I suggested they should throw the offal which was distributed in and around the abattoir into the fly-trap in the following way: Put in a layer of paunch grass and then a layer of waste offal and so on, sandwich fashion, until they had the fly-trap full. I pointed out that in our experience in treating horse dung there was no smell, the only odour would come from the paunch grass. They adopted my suggestion. I visited Mafeking again a week ago and found everybody delighted with the results. The abattoir is almost entirely free of flies, there is no smell, except from the paunch grass in the fly-traps, and the contents of the trap, which are now three months old, are largely decomposed. The contents are now being removed, and used without offence for gardening purposes."

From experience gained in the storage of such waste as that from abattoirs, consisting as it largely does of cow manure and the contents of cattle paunches, it would appear to be necessary to retain it on the larval-trap for some considerable period longer than in the case of ordinary horse manure if immunity from further fly-breeding is to be assured.

Village Sanitation.—The Larval-Trap and Human Fæces.

With small communities, employing a bucket system of removal of human excrement, the final disposal of fæces presents a difficult problem, the disposal trenches frequently proving a grave source of danger from fly-breeding during the warm months.

On the suggestion of Dr. L. G. Haydon, D.S.O., M.B., C.M., D.P.H., Assistant Health Officer for the Union of South Africa, the larval-trap has been employed in connexion with the disposal of human fæces as well as stable manure, the contents of latrine pails being sandwiched between layers of stable manure.

It is found that no nuisance of any kind arises and an excellent fertilizer is obtained. It is thought that the sustained heat of fermentation, i.e., 150° to 160°, is sufficient to destroy any pathogenic organisms which may be present.

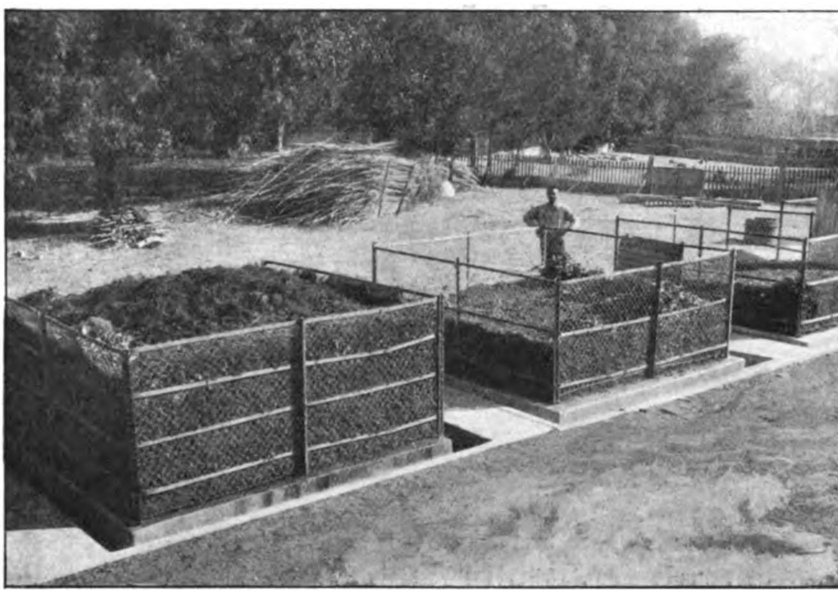
The system has also been extended to the disposal of sewer screenings at municipal sewage works and has been very favourably reported on.

Dr. Haydon has very kindly given permission to quote from a communication which he has received from Mr. Walton Jameson, which proceeds as follows:—

"You will remember when you were here some time ago you suggested that for village work we might try a system of putting down a layer of horse-dung and then emptying the contents of 200 night-soil buckets over this and so on, sandwich fashion, until the trap was full. We adopted the suggestion six months ago. The results have been in every way satisfactory.

The system adopted was to put in eighteen inches of horse-dung and then empty the contents of night-soil buckets on the horse-dung and so on layer after layer until the trap had received about 1,000 buckets of night-soil. The moment the night-soil was covered with horse-dung no smell was noticeable except from the horse-dung, and the whole contents of the completely full receptacle were entirely inodorous.

"After the receptacle had remained full for three months, the contents were emptied and used as a fertilizer with highly satisfactory results. I think it may be finally stated now that such a system may be universally adopted in all small townships with the happy results obtained here. I don't know of a more satisfactory hygienic method which could be adopted,



having regard to economics, than the system suggested by yourself and proved here to be in every way successful."

The remarks of Dr. Herbert Willis, Physician Superintendent of the Mental Hospital, Pretoria, are also of great interest; he writes *inter alia* :—

"Five Baber's enclosures have been put down as a means of dealing with the fly pest. Three of these were built to the plan we had forwarded to us. These were put into operation on about November 1, 1922. The fly pest at that time was very bad, especially at the Native Yards and Staff residences situated fairly close to the stables and piggeries. After the traps had been in use for about a month or so, enormous quantities of fly-larvæ were shovelled up daily, and places that were at one time black with flies showed a very much decreased number."

Finally, I should like to quote from a paper, "Some Public Health

Problems, as viewed from a South African Standpoint," by Dr. L. G. Haydon, D.S.O., M.B., C.M., D.P.H., read before the Sixteenth South African Medical Congress, discussing the subject of the employment of the larval-trap in disposing of animal manure and fermenting waste matters. Dr. Haydon stated :—

"I should like to see this inexpensive system of dealing with manure and kitchen refuse inaugurated throughout South Africa—not only in small dorps, but the bigger towns, and on farms where I know that much of the manure is wasted and washed again by rain.

"I believe that if we had throughout the country reforms in our methods of dealing with human excreta and fermentable (fly-breeding) refuse on the simple and economical lines indicated, we could very appreciably lessen the incidence of intestinal communicable diseases, and that it would no longer be possible to reproach our health authorities with the speedy death of one child in every ten born."

Editorial.

RESEARCH IN THE MEDICAL SERVICES.

In a paper on "Research in the Medical Services," read before the War Section of the Royal Society of Medicine on October 17, the Director-General sounds a note of encouragement to all officers of the Corps; he tells us that research does not necessarily require a special kind of mind and that the qualities most needful are infinite patience and absolute honesty of purpose.

It is true that certain forms of research cannot be carried out without very special training and elaborate equipment; but if we take the wide view enunciated by Sir William Leishman, we must realize that with the opportunities now afforded it is possible for any officer to contribute something to the store of medical knowledge.

In the early eighties, and even as late as 1890, there was little encouragement to seek out new paths of work; new discoveries were not very favourably received as they might upset preconceived ideas and entail some departure from a cherished official procedure. A life devoted to science was supposed to render an officer unfit to hold a high administrative appointment.

Happily, different views are now held. A few years before the outbreak of the Great War a new spirit pervaded the Corps, mainly through the teaching of Sir Almroth Wright. His brilliant lectures and enthusiasm for research made many disciples, who have since contributed much to the advancement of medical knowledge. We believe that this spirit still animates those who teach in our College to-day and officers now receive a technical training fitting them for all fields of research work.

Official recognition of a successful investigation is now almost the rule; brevet rank may be given and officers of comparatively junior rank may receive the coveted distinction of Honorary Physician or Honorary Surgeon to His Majesty, a distinction which in the old days was never conferred on any officer below the rank of Surgeon-General.

Moreover, a research worker does not now necessarily enter a back water and see other officers pass by to the highest ranks in the Service. At present there are four great branches of work in which specialists may rise to the rank of Major-General. A physician or a surgeon may become a consultant to the British Army—a hygienist or a pathologist a director in the War Office, and still be eligible for promotion in the ordinary way. This great advantage we owe largely to the good offices of General Sir C. F. Neville Macready and the late Director-General, Sir John Goodwin.

By the concentration of troops and the establishment of a few large hospitals, with suitable laboratory equipment, in place of scattered garrisons

and a multitude of small hospitals, relics of the old regimental system, the material for research is now to be found in every command.

For those contemplating individual research, Sir William Leishman gives advice which can hardly be bettered; he also instances subjects suitable for collective investigation. There are others which will suggest themselves to those who are interested in hygiene, medicine or surgery, and assistance in any contemplated work can always be obtained from the consultants, both civil and military, and from the Advisory Hygiene and Pathology Committees.

In all the Services periods of depression, such as we are now passing through, are likely to arise; when owing to paucity of numbers and frequent changes of station it seems impossible to do more than just cope with the routine work, but even in these times the spirit of research will surmount all difficulties and bring new interests which will help us to forget our temporary embarrassments. That it is the spirit which counts is abundantly shown by the work which has been done in the past by officers depending entirely on their individual efforts and with little of the training and assistance now offered to all of us. There is also the encouraging thought that we are working for the advancement of human knowledge and are helping to maintain the prestige of a great Service.

Clinical and other Notes.

POLYARTHRALGIA WITH ARTHRITIS OF RIGHT KNEE-JOINT DUE TO PNEUMOCOCCAL INFECTION.

By Captain M. J. WHELTON.
Royal Army Medical Corps.

THE interesting account of pneumococcal polyarthritis which was published in the *British Medical Journal* on September 13, 1924, draws attention to a condition that is not often seen but which exists as a well defined entity.

The following notes on a somewhat similar type of case illustrate how pneumococcal arthritis is at times a self-limiting disease.

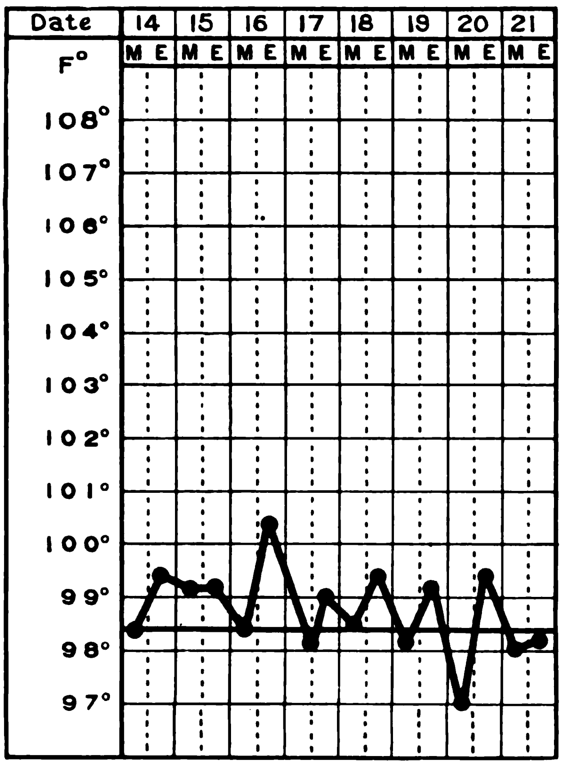
August 12, 1924.—Serjeant W—— reported sick in the afternoon of August 12, 1924, on account of his inability to see the target in the rifle range. There was slight conjunctivitis of both eyes, temperature was 99·4 and pulse was 84. Blood-smear was negative to malaria.

Previous History.—His only previous illnesses were malaria and influenza. His medical history sheet showed that he had had the latter disease in 1918 . . . "A mild attack, free from complications."

August 13, 1924.—He complained of pains and stiffness in all the joints especially along the spine and in the region of both hip-joints. In the afternoon he had extremely severe pain in the right knee-joint. He was thought to be a case of rheumatic fever and was put on the usual treatment. Blood-film was again negative to malaria.

August 14 and 15, 1924.—The pains were still generalized but the right knee had become distended with fluid and was extremely painful.

August 16, 1924.—The urine was found to contain pus-cells with extra- and intracellular Gram-positive diplococci.



August 17, 1924.—The knee-joint was aspirated and 100 cubic centimetres of exudate withdrawn. The fluid was greenish in colour and examination of the sediment which formed showed Gram-positive intra- and extracellular diplococci. A specimen of this fluid was examined at the Brigade Laboratory, Bannu, and pneumococci were detected on culture.

August 21, 1924.—Prostate massaged and a urethral smear thereafter showed pus-cells and cocci of a similar nature to those found in the urine and in the fluid withdrawn from the knee.

August 22, 1924.—Knee-joint aspirated and 100 cubic centimetres of fluid withdrawn. Pus-cells and diplococci present.

August 28, 1924.—Knee-joint again aspirated and seventy cubic centimetres of exudate withdrawn. The fluid was clear and no pus-cells or micro-organisms were found. On this date, too, no pus-cells could be found in the urine. Thereafter the knee-joint returned to its normal size, and the patient was discharged from hospital on September 18, 1924, the joint was stiff and there was a limitation of movement. He had regained full functional use of the joint towards the end of November.

His blood was frequently examined for malaria but with negative results. He had never had pneumonia or venereal disease. His Wassermann reaction was negative. His serum agglutination against typhoid, para. A and para. B was within normal limits for an inoculated man.

It therefore appears certain that he had a generalized pneumococcal infection with special involvement of the right knee-joint. It establishes the fact that some cases of pneumococcal arthritis get well if the fluid is aspirated sufficiently frequently without recourse to more heroic treatment.

I am much indebted to Major J. M. B. Rahilly, O.C. 17th I.G.H., Razmak, Waziristan, for permission to publish these notes, as also to Lieutenant Gill, I.M.S., who did the aspirations.

A-MALAIRIN IN THE TREATMENT OF CHRONIC MALARIA.

By Major J. HEATLY SPENCER.

Royal Army Medical Corps.

Through the courtesy of the proprietors of the Chemical and Research Laboratories a supply of this drug was obtained for trial in India. The active principle of the drug is the glucoside of dioxydiamino-diphenyl-diarsenide. The cases here reported on were chosen specially for both severity of type and frequency of attacks, and were all bad cases of chronic relapsing benign tertian infection, which treatment by quinine and other drugs failed to improve. The object of the trial was to ascertain whether such a type of case could be materially benefited as regards liability to recurring attacks of active malaria. The drug was not used to treat actual attacks, but was given in definite courses with a view to ultimate and not immediate results. For this reason while quinine was withheld in the first cases treated, it was subsequently given when active symptoms were present. It is clear that in chronic infections, already the subjects of extensive quinine therapy, without improvement, its effects could neither enhance nor prejudice the results of the drug under trial. In the cases now reported a provocative effect has been noted in several instances, and it is doubtful if sterilization has been effected in any (possibly in two). The history of each case has been followed as far as military conditions have allowed. The conditions as regards climate and temperature under

which the tests have been made may be said to be ideally severe, as the altitude is 5,500 feet, and severe cold at night follows upon high sun temperature by day, while sudden changes in weather are frequent in the spring, all of which conditions are specially prone to cause recurrences of active symptoms in chronic benign tertian cases. Malignant tertian cases were excluded as it was considered this type would prove a less exacting test of the qualities of the drug. Treatment consisted of four weekly intramuscular injections of 1 c.c., followed by a second course three months later.

Case 1.—Sergeant P——, R.E. (incomplete course given). Contracted August, 1922. Attacks, seventeen to twenty at average intervals of one month. Treatment began January 13, 1924; concluded February 2, 1924. Active malaria with B.T. in blood at commencement of treatment. Spleen + + (two fingers below ribs), liver + tender, cachexia moderate. Clinical symptoms: Rigors, etc.

Subsequent history: Blood positive on February 3, 1924; clinical malaria on February 7 and 10, and March 4, 1924. All while out in camp. Blood positive on March 8, 1924.

Interviewed six months after stated he had been entirely free from all symptoms since the attack of March 4, 1924. Appearance healthy. Owing to this man being away from station the second course could not be given.

Case 2.—Signaller K——G——, B Divisional Signals, contracted June, 1921, at Karachi. Treatment commenced January 27, 1924. Number of intermediate attacks thirty. A very severe case of chronic relapsing malaria which had undergone a special course of antimalarial treatment at Kasauli, on the final day of which he was admitted to hospital with a severe malarial attack. Condition on commencing treatment—Blood positive, spleen + +, cachexia marked. Attacks were then coming on at ten-day intervals. First course concluded February 18, 1924. Blood on January 30 and March 2, 1924, negative. Slight symptoms occurred on February 24 and 29, 1924. Blood, March 2, 1924, negative, on March 12, 1924, positive B.T. On March 19, 1924, admitted to hospital for invaliding and then stated he was much improved as regards severity and frequency of attack. Second course commenced May 28 concluded June 18. Case invalided to England in October, up to which time he had only had two minor attacks not requiring admission to hospital.

Reported by letter (from United Kingdom), dated November 24, in which he stated he was well and had had but a few slight attacks in no way comparable in severity to his former ones. The clinical improvement in this case at the date of departure to the United Kingdom was definite. The cachexia had disappeared, the spleen was just palpable, and the man looked well and stated he was greatly improved.

Case 3.—Signaller Q——, B Divisional Signals. Contracted June, 1922. Admitted for treatment, April 5, 1924. Number of attacks twelve. On admission blood positive. Spleen +. Rigors. First course between

April 8 and 29. No symptoms during first course, which was followed by four slight attacks (at fortnightly intervals) not requiring hospital treatment. Second course given between August 31 and September 27, 1924.

Interviewed at end of November, 1924, stated that he had not been entirely free from attacks but they were much less severe than before treatment. Spleen was then not palpable.

Case 4.—Rifleman S——, 2nd Cameronians. Disease contracted at Kohat, October, 1921. Admitted April 6, 1924. Blood positive. Cachexia marked. Spleen very large, reaching nearly to umbilicus. Liver tender. Rigors. Number of intermediate attacks: three at intervals of about six months. First course given between April 11 and May 2, 1924. Film during course on June 1, 1924, positive. Film on June 10, 1924, positive, accompanied by rigor. Slight attack on August 25, 1924. (Not admitted to hospital.) Second course given between September 5 and 26, 1924, when the spleen had appreciably diminished in size. There was a typical attack just before commencing this course. Admitted to hospital on November 11, 1924, for invaliding. The spleen was then very much smaller, descending one inch below the costal margin on full inspiration. The blood on admission was negative and the general health much improved. This case was invalided to United Kingdom and no subsequent history is available. A third course was given during November, 1924.

Case 5.—Signaller P——, B Divisional Signals. Contracted June, 1923, at D. I. Khan. Admitted April 3, 1924, with positive blood and enlarged spleen. Number of intermediate attacks: seven (at intervals of about six weeks). First course given between April 5 and 26, 1924. No symptoms during course. Second course given between September 12 and October 3, 1924. There were no attacks between the two courses, but the first injection of the second course was followed in forty-eight hours by an attack of fever. Interviewed on December 4, 1924, stated he had been quite well since second course and felt better in every way since treated. The spleen was then just palpable.

Case 6.—Mrs. L——, contracted October, 1923, in Baluchistan. Between October and December, 1923, had very frequent attacks, and again between May and June, 1924. First course given between July 27 and August 17, 1924, was free from fever for about six weeks, when she suffered from attacks every other day for fourteen days. This case would not take quinine. Second course given between November 24 and December 15, 1924. Up to March 1, 1925, there have been no further attacks.

Case 7.—Signaller W——, B Divisional Signals. Contracted at Tonk in July, 1922. Admitted for treatment April 26, 1924, with rigor and positive blood. Spleen enlarged. Number of intermediate attacks, twelve at intervals of two months. First course given between April 29 and May 19, 1924. No symptoms during course, which was followed by three slight

attacks at three weeks' interval, not requiring hospital treatment. Second course given between September 5 and 26, 1924, and followed by three slight attacks.

Interviewed on November 27 stated he had very definitely improved and had never before been free from attacks for so long.

Case 8.—Gunner S——, 38th Field Battery, Royal Artillery. Contracted at Lahore in 1923. Admitted for treatment July 10, 1924. Intermediate attacks, seven. On admission blood positive, rigors, cachexia. First course between July 14 and August 6, 1924. This was followed by two slight attacks not requiring admission to hospital. Second course between November 4 and 25, 1924.

Interviewed on March 15, 1925, stated he had been entirely free since treatment; appeared in robust health.

SUMMARY.—It would be unwise to attempt to express an opinion on the results of so few cases but the author is inclined to consider this drug one of the best combinations of arsenic he has used in the treatment of chronic malarial infections. Two of the cases treated had entirely failed to benefit from treatment by "Eoanophalie." While none of the cases responded immediately to treatment all appear to have derived considerable ultimate benefit.

An official use of this drug on say fifty cases whose histories could be followed for two years after treatment would be of great interest and value.

Travel.

AN ASCENT OF MOUNT ETNA.

By Major M. B. H. RITCHIE, D.S.O.
Royal Army Medical Corps.

(*From the "Field," August* 6, 1925.)

THE idea of making the ascent of Mount Etna came as an eleventh-hour inspiration when about to start on leave from Malta. Visible from that island in clear weather, about 100 miles to the northward, Etna is the loftiest volcano in Europe, being close on 11,000 feet high. Two guide books to Sicily in my possession, both of pre-war date, recommended as taking-off places for the ascent either Randazzo or Nicolosi, inclining to favour the latter, a village ten miles above the city of Catania. Full moon during summer was given as the best time of the year for the undertaking. The first day of leave was full moon, the season summer (June), so without further inquiries—there was no time to get a reply from Sicily—we broke the homeward journey at Catania and motored up to Nicolosi.

Accommodation was obtained at the inn, the head guide interviewed at the office of the Italian Alpine Club, situated in the village, and all arrangements were soon completed for the ascent, which was timed to start at 10 o'clock the following morning. The usual method is by mule as far as

the Observatory, at the foot of the main crater. After a rest of a few hours the climb to the summit is made on foot, arriving in time to see the sunrise.

Delay occurred owing to rain and mist, but our guide, confirmed optimist, proved to be a true weather prophet, as by noon the sky was clear and we could set out upon our journey. The cavalcade consisted of our two selves, each upon a mule, the guide on another and two small boys as muleteers, one of them son of our guide. Food was provided by the inn and carried in saddle-bags along with fodder for the mules and the few warm garments that we possessed. The mules were without bridles and the saddles were primitive.

Above Nicolosi.

Leaving Nicolosi, the track led past the twin peaks of the Monti Rossi, thrown up by an eruption three centuries ago and not yet fully clothed with vegetation. The countryside was splashed everywhere with the yellow of the genista, many plants attaining the dimensions of trees. Wild flowers grew luxuriantly. Here and there were lava streams, legacies of former eruptions, some of which we crossed. Composed of tumbled masses of cinder and burnt stone, they look for all the world like long coal sidings stretching through the verdant country. Houses and the walls enclosing fields, built of black lava, look as if made of coke. The track along which we rode was like a cinder-path ; past us came strings of mules bearing down loads of snow, packed in leaves and branches, for the use of the inhabitants of Catania during the hot weather.

Rising steadily if imperceptibly, the track led on through groves of orange and lemon ; vines were everywhere. Gradually the forest zone was entered, trees being chestnut and oak, copper beech and birch. The path steepened, trees became sparse, more stunted ; the temperature fell, and by four o'clock we had passed out of the forest into the desert region, halting soon after at the staging-point of Casa del Bosco, where mules were fed and watered. After we resumed our journey vegetation soon disappeared, but animal life was represented by myriads of lady-birds, their brown, speckled bodies showing up in sharp contrast to the black, cindery earth. Upwards towards the summit stretched a line of telegraph posts, the wires down, indicating the route to the Observatory. The higher altitudes of the mountain were enveloped in mist and cloud so that little could be seen, and the temperature had slumped to a degree that was bitterly cold in comparison with the pleasant heat of Nicolosi.

The Final Climb.

It was almost seven o'clock when the Observatory suddenly loomed ahead through the drifting cloud, the outline of its dome in the haze giving it the appearance of a mosque. Snow lay in small drifts, turned to gray by a coating of fine ashes from the crater. The Observatory is not inhabited, but it is visited periodically. A portion of the building is used

as a shelter by the Alpine Club, and our guide carried the key. Inside were two rooms lined with bunks, with a kitchen beyond. Behind were stables for the mules and accommodation for the guide and his small assistants. Water was obtained by melting snow. To the British Army, the Observatory possesses historical interest, as on this site stood the Casa dei Inglesi, built by officers of the British garrison of Sicily during the Napoleonic wars, when the French tide of invasion surging down to the toe of Italy, was stemmed by the presence of Nelson's ships in the Straits and a British garrison in Messina. (Another relic is, or was, the notice "Barrackmaster's Store No. 2," on the wall of the cloister in the Hotel S. Domenico at Taormina, but the writer failed to find this in 1922.) Inside the Observatory the cold was little abated, and a fierce, icy wind whistled through the building. Blankets in abundance were stored in the rooms.

We roused our guide about half-past two in the morning, and set out for the summit so as to reach it in time for the sunrise. At a slow, steady pace he went ahead up the steep slope of the crater, the bright moon lighting our way over the rough, boulder-strewn ground. Above us towered the crater, emitting great volumes of smoke into a clear, starry sky now completely free of cloud. A climb of about an hour brought us to the nearest point of the lip of the crater. The edges were sharp and undercut; peering over into the abyss, we could distinguish little owing to the smoke. The crater is about two miles in circumference, but it was not possible to see more than a small sector owing to the dense smoke that was carried across its mouth by a strong north-westerly wind. Working round the edge, we crossed over ground that was hot and moist, with sulphurous smoke issuing through fissures, until we were forced to halt by the margin of the smoke cloud. By this time we were facing east. The slope was extremely steep, and from our perch on the crater's edge we could see into the mouth of a smaller crater below us, its interior growing red and smouldering. This did the damage in the eruption of 1923, and the black track of the lava stream could be traced in the moonlight, winding down the mountain side.

Sunrise from the Crater.

We had to wait twenty minutes in the intense cold, for which we were most inadequately clad, until the sun rose and the view at our feet could be appreciated. At last came the dawn. Over the mountains of Calabria, far beyond the Straits of Messina and at an altitude higher than we expected, appeared a small bright beam resembling a red harbour light. Increasing in size rapidly, it was soon a flaming disc that lighted up the top of the volcano and neutralized the effect of the moon. Gradually the rays descended to lower levels, revealing the slopes of the mountains and the valleys that cut into them, finally reaching the shores of Sicily and the sea beyond. On the mountain range to westward the sun cast a shadow of Etna, showing a sharp profile of the volcano with its smoke

cloud above it. Beneath us lay Taormina, appearing but a short distance away, the ripples of waves on the sea shore visible to the naked eye. The greater part of Sicily and the Calabrian extremity of the Italian mainland lay spread at our feet like a map. The northern coast of the island seemed little more than a few miles away, with the peninsula of Milazzo standing out into the sea. Even the Lipari Islands were in middle distance, the cone of the inoffensive sister volcano of Stromboli smoking steadily. Palermo, however, was hidden from view by mountains. The line of the east coast curved into a series of bays was visible as far as Siracusa, but Malta and the islands in its direction were screened by a faint haze that limited the southern horizon.

A final look at the incomparable view, another peep into the smoking abyss, and the descent was begun. On the return journey we made a *détour* to see the Valle del Bove, a defile with precipitous cliffs, once upon a time another crater. By midday we were back in Nicolosi after an absence of less than twenty-four hours, very fatigued in spite of the assistance afforded by the mules, but thoroughly contented in having obtained the glorious view that can be gained only by a visit at sunrise.

DETAILS.

As regards expenses there is a fixed tariff for services of guide, hire of mules, and use of the Alpine Club shelter in the Observatory. The expenses for two persons amounted to three hundred lire approximately. It would be better to arrange matters previously, as in our case we were gambling on the weather, and if we had started up a day earlier we should have seen nothing; but the weather in summer is usually good and the chances were in our favour. Frequently obscured during the day, the mountain is usually clear in the early morning. This is confirmed by residence upon a hill-top in Malta, whence it is possible to see Mount Etna after sunrise, rarely later. There is no need to put up at Nicolosi, as one can go up from Catania by motor or by the autobus that plies twice daily, returning in the same way the next day. According to the book kept in the Alpine Club office, we seemed to have been the first of our compatriots to make the ascent that year (1924). Unpretentious, the inn at Nicolosi was clean and comfortable, the food good and the proprietress most obliging. Civility was universal; the head guide and Carbonaro, our guide, were delightful fellows with all the charm of the mountaineer about them. An hour after our return we saw the head guide clad in white, picturesque, flowing robes that bore a trace of the Saracen about them, taking part with the other men of the village in a procession, and the solemnity of the occasion did not preclude him from saluting us with a courtly bow.

The characteristics of Mount Etna are in marked contrast with those of other mountains, It is devoid of the usual defiles, rocky crags, or narrow tracks bordered by precipices. Instead, one has the impression of

mounting up an unrolled and interminable cinder-path. From the edge of the desert region upwards, the mountain side is a wide plain set at a steep angle, over which there is no question of moving in Indian file, as a division of cavalry could advance over it in line right up to the Observatory. At the summit the black, forbidding waste and the vast opening from the bowels of the earth, belching out volumes of sulphur fumes in a dense cloud, are to the infernal what the beautiful panorama of gorgeous country and sapphire sea is to the celestial. Mount Etna is, in effect, a colossal slag-heap, and it is up the far end of such a heap, shuffling through soft cinders and lumps of coke, that one seems to toil when making the ascent of this king of European volcanoes.

Current Literature—Hygiene.

The Solubility of Glazes and Enamels used in Cooking Utensils. By G. W. Monier-Williams, M.A., Ph.D., F.I.C. (Reports on Public Health and Medical Subjects, No. 29.) Ministry of Health, London. H.M. Stationery Office, 1925, price 6d. net.

(1) *Previous Work.*—Concerned almost entirely with the danger to health of workers engaged in the application of glazes to pottery, and did not deal with the action of acid foodstuffs on lead, although the experimental work carried out has an intimate bearing on the subject. The glaze consists of lead oxide fused or "fritted" with silica. It appears that the solubility of the finished lead glaze in acid foodstuffs is governed by two factors: (i) The proportion of silica present in the raw glaze applied to the ware; (ii) the extent to which the glaze takes up further silica from the ware during the process of firing.

E. V. Raumer and E. Spaeth investigated two cases of lead poisoning caused by eating whortleberries stored in six-litre earthenware pots. Serious cases of poisoning had resulted with two deaths. In one case the berries contained 2·48 grammes of lead and the pot on further treatment with four per cent acetic acid yielded a further 0·4245 gramme of lead. Tests were carried out in 1919-20 by Miss Masters on glazed earthenware casseroles treated with one per cent citric acid for half-an-hour. French casseroles yielded 2·0 to 8·1 milligrammes of lead oxide per square decimetre of glazed surface and from 1·0 to ten parts lead per 100,000 solution. Certain English casseroles yielded nineteen milligrammes per square decimetre of surface (20·7 pints per 100,000 solution). Only three out of the eighteen samples could be classed as free. Cooking fruit and vegetables in these casseroles gave soluble lead extracted from 0·75 to 3·4 milligrammes per 100 grammes foodstuffs, although one case gave as much as 25 milligrammes of lead.

(2) *Importation and Home Manufacture of Lead-glazed Cooking Ware.*—Most of the cheap lead-glazed cooking ware used in this country is imported from three main districts in France. (*a*) *Alpes ware*, usually red-glazed on inner surface. (*b*) *Digoin ware*, light coloured, glazed on inner and partially on outer surface. (*c*) *Lille ware*, flat dishes, yellow glaze on inner and dark brown on the outer surface. The English lead-glazed ware found by Miss Masters to yield a high proportion of lead was made in a small pottery. As far as can be ascertained the larger firms in this country use only leadless glaze for cooking ware. In the smaller potteries the glaze is applied by hand and consists of: 30 lb. red lead, 18 lb. "band" clay, 8 lb. ground flint, 2½ oz. plaster of Paris, ½ oz. washing soda. After dipping, the casseroles are air-dried and then kilned at a temperature of about 1000° C. The higher the temperature and the longer it is kept at that temperature the greater the extent to which the lead of the glaze combines with the silica of the body. This decreases materially the solubility of the glaze. Four or five years ago the English pottery referred to used a glaze having less clay and no plaster of Paris and a firing temperature of 800-850° C. The composition of the glaze has now been altered to that given above and firing temperature increased to 1000° C. with improved results.

(3) *Laboratory Experiments on the Solubility of Lead Glazes. Method used.*—Vessels to be tested were filled with one per cent citric acid solution in distilled water and the solution heated and kept simmering at one to two degrees below boiling point. Samples of the solution were withdrawn every half hour and the amount of lead estimated calorimetrically by comparison with standard lead solutions prepared with citric acid.

Preliminary experiments were done on two casseroles purchased in London; one French and the other English. These were heated with one per cent citric acid solution for half an hour and afterwards two further periods of half an hour with fresh citric solution. The French vessels gave from 0·53 to 1·0 parts per 100,000 of solution and the English 0·28 to 1·2 parts.

Experiments were now carried out on Alpes, Lille, Digoin and English ware. The vessels were filled to the brim with one per cent citric acid in distilled water, allowed to simmer and samples examined every half hour.

The results showed that the Alpes ware gave the highest quantity of lead dissolved. Two Lille and two Digoin samples gave high results. Of the English only one yielded more than mere traces of lead. This was an old specimen manufactured before the introduction of the new glaze and higher firing temperature.

The amounts of lead dissolved by the citric acid was in many cases extremely high, e.g., in one case of Alpes ware the solution at the end of four hours contained as much as 0·02 per cent of lead and would presumably be highly poisonous. It was noticeable that the maximum amount of lead was reached after a certain time and was not increased by further heating.

but if the pot was subjected to fresh treatment with citric acid solution a further quantity of lead was dissolved which reached or even exceeded the amount obtained by the first treatment, e.g., in one case six successive treatments each gave twenty-six milligrammes of lead per square decimetre, but this amount could not be exceeded by more prolonged heating.

Under domestic conditions it is unlikely that casseroles would be subjected to such prolonged treatment with a solution of this degree of acidity. Some tests were therefore carried out on Alpes ware using typical foodstuffs.

The results gave 0·3 to 0·4 parts lead dissolved per 100,000 of foodstuff; and on subsequent treatment with one per cent citric acid 1·5 to 7·8 parts per 100,000 citric solution.

On a second series of experiments on Alpes, Digoin and Lille wares, using apples and rhubarb, the amount of lead dissolved varied from 0·1 to 0·4 parts per 100,000, and on subsequent citric acid treatment 0·6 to 0·8 parts per 100,000 were dissolved.

There is considerable discrepancy between the two sets of figures, the amount of lead taken up being much higher in the first than in the second series. In the second series the amount of lead taken up is out of all proportion to the amounts dissolved by the citric acid of only slightly higher acidity. Analysis of the first series was done in 1921, and the second series three years later on a fresh series of casseroles, and possibly the latter were better glazed.

It is not possible to trace any relationship between the acidity of the foodstuff and the amount of the lead dissolved.

One possible reason for the difference in amounts taken up between the citric acid solution and foodstuffs may be that the citric acid solution was made up with distilled water. The absence of dissolved salts may favour solution of the lead. Experiments were therefore done with casseroles treated with boiling tap water and boiling distilled water.

Results :—

Lead dissolved mg. per sq. dm. of glazed surface		
Tap water		Distilled water
(1) *Nil*	..	0·2
(2) 0·2	..	0·7

The differences, although considerable, are not sufficient to account for the dissimilarity observed between the cooking and citric acid experiments.

These results indicate the difficulty of drawing conclusions from the figures obtained by prolonged heating with citric acid solutions, while from the second series the amounts of lead taken up by the apples and rhubarb may be regarded as negligible, the figures obtained from the first indicate that a certain amount of lead contamination may occur.

The limit of lead content recommended as allowable in tartaric acid, citric acid, and cream of tartar, is two parts per 100,000 (A. W. J.

MacFadden, L.G.B. Food Reports, No. 2, 1907). In food products containing these ingredients, the proportion of lead derived from them would amount perhaps to 0·02 to 0·04 parts per 100,000, figures which are similar to those of the second series of experiments.

It is apparent that these glazes are fairly resistant to the solvent action of foodstuffs, but under prolonged action of acid solutions lead may be dissolved to a dangerous extent.

Leadless glazes are used by most English manufacturers of cooking ware; there does not seem to be any reason why lead should be used, and again it is comparatively simple for a manufacturer to produce lead glazes which show negligible solubility on prolonged citric acid treatment. Evidently much of the ware imported from the continent is of a low standard in this respect, and sufficient care has not been taken in the control of temperature and duration of firing.

Enamelled Hollow-ware Vessels.—Enamels are made up of some or all of the following: borax, felspar, quartz, fluorspar, cryolite, china clay, lime magnesia, sodium nitrate, sodium hydroxide, and other materials. These are fused together and then mixed with oxides of cobalt, antimony, iron, manganese, or nickel, according to character or colour required. Two coats are applied: a black fused at a temperature of about 1000° C., and finally the white or coloured fused at a lower temperature.

Samples of seven different makes were obtained, the enamel chipped off and examined. The amount of silica present varied from forty-four to fifty-five per cent. Iron in large amounts was found derived from the iron-ware itself; cobalt in blue and mottled enamel. Lead and phosphoric acid were present in traces in all samples. Fluorine was present in all cases, varying from 0·3 to 4·7 per cent.

Arsenic was not found in any sample.

All samples contained boric acid in large amounts. One sample contained both antimony and tin, and the remainder contained tin alone as an opacifying agent.

Sulphide samples were heated with one per cent citric acid solution at a temperature just under boiling point for four hours.

The major part of the material brought into solution was in most cases aluminium and iron.

Tin.—The amount dissolved cannot be considered excessive. The highest amount being 0·027 gramme per litre of solution, or less than 0·2 grain per pound.

Antimony.—The highest amount of antimony was 0·07 grain per pound. The opinion is expressed that, as the results of animal experiments, antimony in the pentavalent form is not poisonous, at any rate in quantities which would be dissolved from enamel. It is however possible that in certain enamels the antimony may be reduced to the trivalent state, when its toxicity would be greater.

Boric Acid.—Appeared in traces up to 0·22 gramme per litre, and, in

one case, the large amount of 4·74 grammes per litre. This case was of Canadian manufacture. A cooking experiment was done on another pan of this manufacture, using tomatoes. The raw tomatoes contained 0·0012 per cent boric acid, and after grilling in the pan contained 0·0091 per cent, an increase of 0·008 per cent boric acid.

This amount is not considered excessive, but under certain conditions, e.g., cooking of acid foodstuffs in this pan for a long time, considerable quantities may be dissolved.

Apart from this one instance, the probability that undesirable constituents in significant amounts may be dissolved from enamelled hollow-ware during ordinary cooking is remote.

"The Effect of Radiation on the Production of Specific Antibodies." By P. Hartley. *British Journal of Experimental Pathology*, 1924, vol. v, p. 306.—Following the work of Colebrook, Eidinow and Hill, who found that exposure of rabbits, etc., to various types of radiation increased the bactericidal power of the blood against the staphylococcus and a streptococcus of the *fæcalis* type, the author has examined the effects of radiation upon rabbits and guinea-pigs during immunization, by means of the mercury vapour lamp, carbon arc, X-ray, etc.

Using animals in the process of immunization against diphtheria and typhoid he failed to find any definite change in the antitoxin production of the former or the agglutinin content of the latter as a result of exposure to these radiations.

The frequently observed fact, that repeated small bleedings at short intervals may be followed by increase in typhoid agglutinins in immunized animals, is also noted by the author. H. D. B.

The Fermentative Reactions of the Diphtheria Bacillus. By C. C. O'Kell, M.C., M.B.Camb., M.R.C.P.Lond., and E. M. Baxter, M.Sc.Sheff. The Wellcome Physiological Research Laboratories. From the *Journal of Pathology and Bacteriology*, 1924, vol. xxvii, p. 439.—The authors instigated this investigation: (*a*) To attempt to explain the discrepancies in the literature on the subject; (*b*) to attempt to separate virulent from avirulent strains of *Corynebacterium diphtheriæ* by the biochemical reactions; (*c*) to check the uniformity of the biochemical reactions of various serological groups of virulent *Corynebacterium diphtheriæ*.

Stress is laid on the necessity of making quite certain that cultures to be tested are pure. Contamination may be so slight as to be difficult of detection in stained preparations, and repeated platings may be necessary to ensure purity. The most common contaminating organisms are streptococci, staphylococci and organisms of the necrosis group. The purity of organisms which are found to ferment saccharose merits special scrutiny.

Virulence was tested in all cases by the intradermic method, which proved thoroughly satisfactory.

Special care was found to be necessary in preparing the medium used for testing the biochemical reactions. Contrary to the usual practice, a

broth basis was used instead of Hiss's serum water. The following is the technique of its preparation.

Double strength litmus broth is prepared as follows :—

Nutrient broth	..	..	100 c.c.
Aq. dist. ..	..	..	100 c.c.
Witte peptone	..	..	3 grm.
Sodium chloride	..	..	2·1 grm.

and a sufficient quantity of litmus solution is then added for the subsequent dilution with the sugar solutions. The pH is then adjusted to 7·6, and about two-cubic-centimetre quantities are added to test-tubes which are then plugged and autoclaved at fifteen pounds to the square inch for twenty minutes. Each tube filled in this way is marked with a glass and china pencil so as to allow of the addition of an approximately equal volume of the sugar solution. The troublesome use of graduated pipettes is thus avoided. Solutions consisting of 0·5 per cent to 1·0 per cent of the sugar (according to the reagent) in distilled water are filtered through a sterile Pasteur-Chamberland filter which has been previously tested. Each of the litmus broth tubes is then filled to the pencil mark with the sugar solution, added with sterility precautions by means of a bulb pipette. The tubes of media are then incubated for forty-eight to seventy-two hours to ensure sterility, and any tubes showing contamination are rejected. Such filtered reagents are quite easy to prepare and have given entirely consistent results.

Results of Fermentation Tests.—430 strains were carefully tested. Of these, 200 which were virulent to guinea-pigs without exception fermented glucose and failed to ferment saccharose, 4 fermented neither, thus falling into the Hoffmann group, and 26 fermented both, thus falling into the Xerosis group.

The fermentative action of both virulent and avirulent strains on certain other media (lactose, glycerol, maltose, galactose, dextrin and litmus milk) was tested in the hope that some differentiating point might be discovered. None, however, was elucidated, and the authors conclude that there is no evidence that the fermentation of the customary reagents is of any value in distinguishing virulent from avirulent strains.

Examples of the seven most important serological groups of *Bacillus diphtheriæ*, including the "Park Williams 8" strain and two avirulent organisms, were carefully tested on a large range of sugars. They were re-examined after intervals of subculture of 18, 23 and 33 months, and showed no variation in their reactions during these periods. The fermentation reactions thus appear to be consistent.

The following explanations of the discrepancies occurring in the literature were suggested : (*a*) insufficient precautions as to the purity of the cultures ; (*b*) insufficient separation of virulent from avirulent strains ; (*c*) insufficient care in the preparation of the reagents, particularly of the di- and poly-saccharides which readily hydrolyse on heating ; (*d*) insufficient care to ascertain that free growth occurs in the media used.

J. S. K. B.

Reviews.

THE STOMACH AND UPPER ALIMENTARY CANAL IN HEALTH AND DISEASE. By T. Izod Bennett, M.D., M.R.C.P. London: William Heinemann (Medical Books) Ltd. 1925. Pp. xv + 344. Price 21s. net.

Dr. Izod Bennett's book contains an account of the present-day knowledge of the medical aspect of disorders of the upper alimentary canal, including advances made in physiology and pathology. Before considering diseases of the tongue, buccal mucosa, salivary glands and teeth, he has a chapter on the physiology of the mouth; and before entering upon organic diseases of the stomach there is first a chapter on its physiology. It is, perhaps, this good arrangement that is one of the noticeable features of the book. The author has a readable and clear style that gives simplicity to a complex subject, and he states his own opinions definitely, admitting that he is prepared to revise them in the light of later progress. It is an exceptional book that will attract much attention, and its instructive value is increased by the large number of charts, plates and illustrations which it contains. The author's preface begins quaintly: "A French lady visiting this country remarked to me that she now understood the beautiful table-manners of our race, for the food was so uniformly unpleasant that to call attention to it in any way would clearly be indiscreet."

M. B. H. R.

LEPROSY. By Sir Leonard Rogers, C.I.E., M.D., F.R.C.P., F.R.C.S., F.R.S., and Ernest Muir, M.D., F.R.C.S.Edin. Pp. 301 + xii, with many illustrations. Bristol: John Wright and Sons, 1925. Price 10s. 6d. (paper), 12s. 6d. (cloth).

The ancient physician wishful to master the diagnostics of leprosy could open his English translation of *Dolæus*—a rathe primrose now dying forgotten on one of the endless bookshelves in the British Museum—and read there, "The Leprosie is that which affecteth the whole Body or part thereof with Scurfflike Scales." Then close the volume and say complacently, "So much for leprosy." A first fine careless rapture, alas! not to be recaptured by the modern toiler who must study a lengthy monograph before claiming even a working acquaintance with this, or almost any other disease.

The authors of the masterly treatise noticed here set out to "summarize the most important previous literature having a practical bearing, and give a clear clinical account of leprosy and its treatment, based on large personal experience, with special attention to the early and more amenable stages"; an aim and intention which they have fully attained.

The volume consists of six sections, and a recital of these will give a better idea of the scope of the work than a more detailed description. Section I (50 pages), History and Distribution; II (50 pages), Epidemiology and Communicability; III (39 pages), Prophylaxis; IV

(26 pages), Etiology; V (78 pages), Clinical; and VI (44 pages), Treatment. This last section will probably attract the practically-minded reader's attention first. The methods of treatment advocated are set out with reasoned fairness and an absence of any unsubstantiated claims. The combination of therapeutic agents suggested is—

(1) Injections twice a week of the following:—

Ethyl ester hydnocarpate Olive oil (free from fatty acids)	of each 50 c.c.
Thymol	10 grm.

Dose: 1 to 10 c.c. by subcutaneous infiltration under lesions, and intramuscular injections.

(2) Painting the lesions every seven to fourteen days with 1—3 to 1—5 solution of trichloracetic acid in distilled water.

(3) Potassium iodide in daily doses of ½ to 20 gr.

(4) With the above, general remedies, tonics, exercises, balanced diet, and so forth.

From the figures of the last three years the authors estimate that the reduction in the number of lepers in Hawaii, for example, will amount to almost one-half within the decade.

Parts of the historical section fall short of the authoritative standard of the other portions of the volume, and form the basis of a paper appearing elsewhere in this issue of the *Journal*. W. P. M.

A Life-size Anatomical Model of the Human Body, with Handbook. By George Philip and Son, Ltd. Price £3 3s.

This model has been lithographed in natural colours on linen cardboard to hang up and open out in sections. It shows the blood-vessels, nerves, muscles, internal organs and the skeleton.

Part I shows the musculature of the anterior surface of the body.

To the right the superficial muscles are partially removed in order to bring the deeper muscles into view. In this part eighty-five muscles, or tendons, are shown, and with each there is a short note giving its situation or action.

In the second part the musculature of the posterior surface of the body is displayed. On this sheet also parts of the superficial muscles have been removed here and there so that the deeper-lying layers may be recognized. At the occiput a portion of the cranium has been cut away through which the position of the brain in the cavity of the skull can be seen. The dura mater, right occipital lobe and cerebellum are displayed. Then follow sixty-eight pictures of muscles with short explanatory notes. We notice that the plantaris muscle is stated to serve as a tensor of the plantar fascia. This is true of animals but not of man.

The third part is devoted to the circulation of the blood. There are fifty-four pictures, which are followed by a third sheet, which shows the lacrymal ducts, trachea, diaphragm, right kidney, left kidney, rectum and bladder.

In the fourth part the nervous system is dealt with. The skull cap has

been removed longitudinally, so as to show the contents of the skull. The right and left hemispheres, superior longitudinal sinus, corpus callosum, one of the optic thalami, hypocampus major, pineal gland, etc., are shown. Many of the cranial nerves, the spinal cord, and a number of the cervical, thoracic and lumbar nerves, and parts of the sympathetic system are demonstrated. Then follow important muscular and cutaneous nerves. Altogether in this section there are seventy-six demonstrations, which should enable a student to get a good idea of the nervous system.

The skeleton and the viscera are shown in the fifth part. There are 101 figures in the section illustrating the skeleton and sixty-one devoted to the viscera. The whole makes a very complete demonstration of the skeleton and viscera of the body.

The preparation has been carried out with a great amount of detail. The model should prove of great use in demonstrating to elementary classes in anatomy and junior medical students when a dissected body is not available. It requires careful handling in displaying the various parts, as the connexions are distinctly fragile.

ORGANIZATION FOR WAR WITHIN AN INFANTRY BATTALION. By Colonel T. N. S. M. Howard, D.S.O. Aldershot: Gale and Polden, Limited. Pp. 15. Price 1s. net.

Colonel Howard's intention in this pamphlet is to formulate a sound and practical war organization for a battalion. As he points out, establishments can be found in "War Establishments," but no present textbook gives an approach march formation, or a normal formation of readiness for deploying into an attack formation.

His pamphlet is divided into four parts—the organization within the battalion, normal approach march formation, formation of readiness, and organization within the platoon. In all these matters he gives details of infantry organization that are in amplification of the official instructions. Infantry officers speak well of this pamphlet, as would be expected, for the author has commanded both an infantry battalion and a brigade in peace and war for some years and knows his subject intimately. The writer of this note remembers him as a keen soldier in pre-war days. Obviously, that keenness has not abated. M. B. H. R.

INDEX TO VOLUME XLV.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

At the request of subscribers all the items that have appeared during 1925 under the heading "Correspondence Circle" have been included in the Index to Volume XLV.


VALENTINE'S PREPARATION
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The result of an original Process of Preparing Meat, and extracting its Juice by which the elements of nutrition are obtained in a state, ready for immediate absorption.
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